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ABSTRACT

This student welding competency-based education curriculum consists of six units dealing with general areas related to trade occupations and nine units covering specific aspects of working with welding equipment and performing welding operations. Topics covered in the first six units are welding opportunities, human relations, safety, basic mathematics, measuring, and reading blueprints. The remaining nine units deal with the following areas: (1) operating shield metallic arc welding equipment; (2) operating gas welding equipment; (3) operating metallic and tungsten inert gas equipment; (4) set up, tack, and weld metal processing projects; (5) cleaning, testing, and classifying metals; (6) operating auxilliary equipment and tools; (7) performing structural or equipment welding and cutting operations; (8) welder certification tests; and (9) supervision, training, and job estimating. A total of 100 competencies are addressed in the student competency sheets constituting these units. Each student competency sheet contains a task statement, a performance checklist, a list of materials needed, a performance standard, and learning activities. (MN)

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ED203018

CE 028 975

STUDENT MATERIAL

for

COMPETENCY-BASED EDUCATION CURRICULUM

for

WELDING

Prepared by

ASSOCIATED EDUCATIONAL CONSULTANTS, INC.

North Allegheny Office and Research Park
McKnight and Pine Creek Roads P.O. Box 15073
Pittsburgh, Pennsylvania 15237

Produced at

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This student material was developed by Associated Educational Consultants, Inc., through the cooperation and support of the Bureau of Vocational, Technical and Adult Education, West Virginia Department of Education, Charleston, West Virginia.

December 1980

U.S. DEPARTMENT OF HEALTH.
EDUCATION & WELFARE
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PREFACE

This competency-based education (CBE) Welding Curriculum was developed for West Virginia by Associated Educational Consultants, Inc., Pittsburgh, Pennsylvania, with the help of teachers of welding programs. The effort was coordinated by the staff of the Bureau of Vocational, Technical and Adult Education.

The Bureau began advocating CBE curriculum in 1974. Since that time, West Virginia has produced over twenty CBE curricula in various occupational areas. We also have a number of CBE curricula currently in the process of being developed and/or field-tested. This Welding curriculum was disseminated to West Virginia teachers through workshops in the Spring of 1981. Additional copies of the curriculum are available from:

Vocational Curriculum Laboratory
Cedar Lakes Conference Center
Ripley, West Virginia 25271
(304) 372-8673

I trust this curriculum will help your program. Any suggestions you may have for improving it may be sent to our State Curriculum Lab. Through this feedback we plan to continually update our materials.

VOCATIONAL, TECHNICAL AND ADULT EDUCATION

Clarence E. Burdette
Assistant State Superintendent of Schools

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STUDENT COMPETENCY SHEETS FOR WELDING CURRICULUM
  UNITS A, B, C, D, E, F: I - IX

ACKNOWLEDGEMENTS

The planning, organizing, and coordinating of the development of this competency-based curriculum for welding required the working together of many people of specialized skills and abilities. Associated Educational Consultants, Inc., (AEC) relied heavily on Dr. James Rosebrook and Mr. Kyle McGraw, formerly of the Bureau of Vocational, Technical and Adult Education, Mr. Marshall Hamilton, Supervisor of Trade and Industrial Education, and, particularly, Dr. Fred W. Harrington, Coordinator of Curriculum Development.

Teachers of the welding programs in West Virginia provided assistance by submitting lists of references used in their programs and information on the welding systems taught.

Several teachers gave special assistance, providing helpful suggestions and assisting in various ways at the several stages of the project. Particular recognition is due Mr. Edward Beavers, of Taylor County Vocational Center, who gave of his time on the Task Force and also served as a Content Consultant. Mr. Howard Thomas, Fayette Plateau Vocational-Technical Center, and Mr. John Pedro, Raleigh Vocational-Technical Center, also served as Content Consultants, writing Learning Activities for identified competencies. And very special thanks must be accorded to Mr. Ronald Harrington, North Hills School District, Pittsburgh, Pennsylvania, who served not only as Content Consultant, but also as advisor and coordinator.

A debt of gratitude is owed also to those many people who took time from their busy schedules to respond to the task validation survey: instructors of welding programs in West Virginia and Pennsylvania, and welders and supervisors of welders in both states.

STUDENT CURRICULUM

INTRODUCTION

This material is designed as a student Welding Competency-Based Education (CBE) Curriculum. It has been developed to facilitate the learning of skills necessary for a career in welding. The tasks in this curriculum are those actually performed "on the job." The Student Competency Sheets are intended for use by students and/or the instructor.

A Teacher's Guide accompanies this curriculum. The guide contains an explanation of the curriculum--its validated basis, the construction and the uses. It also contains competencies by job title, an equipment list, a list of references used in the curriculum, and suggested evaluation instruments.

HOW TO USE THIS CURRICULUM

As you read the Table of Contents, you noticed that the competencies of this curriculum have been grouped into major sections called "Units." A "unit" is a major segment of work made up of related tasks.

A sub-group, within a Unit, is called a "Module." Each Module is made up of several closely-related "Tasks." These have been grouped together as a Module because these related skills may be learned at about the same time.

A "Task" is a job-related competency which constitutes logical and necessary steps in the performance of a segment of the worker's overall responsibilities. Another way of saying this is that a task has a definite beginning and ending point, and between the beginning and ending there are definite steps to be performed.

Each Student Competency Sheet (SCS) pertains to a single "task," which requires performance of five (5) or more steps in order to accomplish the task. In other words, when satisfactory performance of all the "steps" is attained, as listed in the "Performance Checklist," the competence required for that "Task" has been mastered.

Turn to a Student Competency Sheet and look at the format.

In the upper section of the SCS (above the first solid line) you see "Unit" and a Roman numeral and the name of the unit on the line below the words "Student Competency Sheet." The second line shows Module A or B or C, etc., and the name of the group of related tasks. The third line tells you the number (1, 2, 3, etc.) and the name of the Task. This is the job-related competency.

What To Do With a Student Competency Sheet

The first major section of the Student Competency Sheet (SCS) is the "Performance Checklist." The steps listed here serve two purposes. First, they tell exactly what must be done to perform the task. The steps are listed in order. The task can be performed by following the Performance Checklist as it is numbered. As the steps are performed, evaluation can be done. Thus, the second use of the Performance Checklist is as a competency-based "test": can this job be done or do skills need to be sharpened in one or more of the steps?

The second section on the SCS tells more about the competency "test." The "Test" portion lists:

1. Items Needed - what will be needed (equipment, tools, materials, etc.) to perform the task.
2. Task - what must be done.
3. Standard - how well the task must be done or, in other words, the standard to which the task must be performed.

The last section of the SCS suggests "Learning Activities" which are recommended in order to be able to perform the task. They include things that can be read, seen, and heard. And they suggest situations for practicing skills related to the task. Many additional activities are possible. By the time some or all of the Learning Activities have been completed, why and how to perform the task should be mastered.

Performance means:

1. Understanding why the task is done and what's involved in understanding the why's.
2. Being able to perform the task efficiently and effectively.
3. Being able to feel comfortable while performing the task and becoming a "good" worker. A "good" worker should be cooperative and confident and be able to relay confidence to others.

Many Student Competency Sheets are too long to fit on one page. Don't overlook that second page!

SCS Packets

Some Student Competency Sheets will have extra pages immediately following them. These pages may be Information Sheets, which supplement textbook or audio-visual information. There may also be a Self-Check Test. (Questions on a Self-Check Test should be answered without looking at the answers. After completing the test, then answers can be checked and discussed.) There may be an "Instructor Check Sheet," which is also a guide. Sometimes the items on the Instructor Check Sheet are the same as listed in the Performance Checklist on the SCS; other times, two or more steps have been combined for evaluation purposes.

These supplements to an SCS will be keyed in the upper right-hand corner of the page. For example, I-A-1 means Unit I, Module A, Task 1. When additional pages are included after the first page of a Student Competency Sheet, each page will be identified, for example as $\frac{\text{I-A-1}}{2}$, $\frac{\text{I-A-1}}{3}$, etc.

The only exceptions to this numbering system are the units called Unit A, Unit B, etc. (alphabetical instead of Roman numerals). For these units there are no Modules. There are only Tasks, which are numbered as 1, 2, 3, etc. Therefore, additional pages which accompany the SCS for Unit A, Task 1, are called $\frac{\text{A-1}}{2}$, $\frac{\text{A-1}}{3}$, etc.

When working with a Student Competency Sheet, be sure all the pages included for that task are identified. Also, check to see if any other supplemental material is available.

Your instructor will evaluate your performance of each task. There will also be some written tests. The instructor will give you these tests to help determine your grade.

WELDING CURRICULUM

TABLE OF CONTENTS

UNIT MODULE TASK

A. Employment Opportunities

    1. Look for a job
    2. Write a personal data sheet (resume)
    3. Complete a job application form
    4. Prepare for a job interview

B. Human Relations

    1. Understand yourself
    2. Understand successful work attitudes
    3. Use principles of human relations

C. Safety

    1. Maintain personal safety
    2. Maintain general shop safety

D. Basic Mathematics

    1. Compute whole numbers
    2. Compute common fractions
    3. Compute decimal fractions
    4. Calculating/expressing percentages, averages, and estimates

E. Measuring

    1. Use basic measuring tools
    2. Convert to metric values

F. Reading blueprints

    1. Identify basic print information
    2. Identify metal shapes, views, and sections
    3. Interpret welding abbreviations and symbols

I. Operating Shielded Metallic Arc Welding Equipment

  A. Equipment Set Up

    1. Set up machine for current requirements
    2. Remove or replace SMAW equipment accessories

B. Welding

  1. Shielded metallic arc-weld carbon steel
  2. Shielded metallic arc-weld heat and corrosion resistant (stainless) steel
  3. Shielded metallic arc-weld cast iron

C. Cutting and Build-up/Hard Surfacing

  1. Hard surface steel with arc-welding equipment
  2. Cut carbon steel using shielded metallic arc cutting process
  3. Cut carbon steel with air carbon arc process
  4. Cut cast iron with air carbon arc process

II. Operating Gas Welding Equipment

A. Equipment Set Up and Maintenance

  1. Set up portable or stationary oxy-fuel equipment
  2. Change oxygen, acetylene or MAPP gas (methylacetylene propadiene) cylinders
  3. Clean welding and cutting tips on oxy-fuel equipment
  4. Perform soap and water and/or submerged leak test and repair gas welding equipment

B. Cutting and Shaping Materials

  1. Cut carbon steels with oxy-acetylene equipment
  2. Forge metals with gas equipment
  3. Shape metals using gas welding equipment
  4. Remove distortion using gas welding equipment

C. Brazing and Soldering

  1. Braze ferrous and non-ferrous metals with gas equipment
  2. Silver braze ferrous and non-ferrous metals with gas equipment
  3. Lead solder ferrous and non-ferrous metals with gas equipment

UNIT MODULE TASK (Continued)

D. Welding and Braze Welding

1. Gas weld carbon steels
2. Gas weld cast iron
3. Gas weld copper or copper alloys
4. Braze weld carbon steel
5. Braze repair cast iron castings

III. Operating Metallic and Tungsten Inert Gas Welding Equipment (TIG), (MIG)

A. Equipment Maintenance

1. Disassemble and clean a GMAW (MIG) torch assembly
2. Disassemble and clean a GTAW (TIG) torch assembly

B. Welding with MIG Equipment

1. Weld carbon steels with GMAW (MIG) equipment
2. Weld stainless steel alloys with GMAW (MIG) equipment
3. Weld aluminum or aluminum alloys with GMAW (MIG) equipment

C. Welding with TIG Equipment

1. Weld carbon steels with GTAW (TIG) equipment
2. Weld aluminum or aluminum alloys with GTAW (TIG) equipment
3. Weld heat and corrosion resistant (stainless) steels with GTAW (TIG) equipment
4. Weld copper or copper alloys with GTAW (TIG) equipment
5. Weld chrome-moly steel with GTAW (TIG) equipment
6. Weld magnesium alloys with GTAW (TIG) equipment

IV. Set Up, Tack and Weld Metal Processing Projects

A. Organizing for Welding

1. Research technical publications for welding standards
2. Draw sketches for shop or field projects
3. Select metals for fabrication from blueprint specifications
4. Clamp metal work to prevent distortion and tack weld

UNIT MODULE TASK (Continued

B. Set Up and Tack Weld Different Joints

1. Set up and tack weld tee joints
2. Set up and tack weld lap joints
3. Set up and tack weld open butt joints
4. Set up and tack weld edge joints
5. Set up and make a plug or slot weld

C. Set Up and Tack Weld in Different Positions

1. Set up and tack weld in the flat position
2. Set up and tack weld in the horizontal position
3. Set up and tack weld in the vertical position
4. Set up and tack weld in the overhead position

V. Clean, Test and Classify Metals

A. Clean, Test and Classify Metals

1. Examine and identify metals
2. Clean metals with solvent
3. Test metals using guided bend tester
4. Inspect welds using dye penetrant methods

VI. Operating Auxiliary Equipment and Tools

A. Hand Tools

1. Cut materials with hand hacksaws
2. Chip slag using chipping hammer
3. Finish metal surfaces with hand tools

B. Power Tools

1. Shear and punch metal shapes using iron working machines
2. Drill metal using power drilling equipment
3. Cut metal with power hacksaw or bandsaw
4. Grind metal with power equipment

C. Use Rod Oven

1. Set oven temperature and store arc electrodes

VII. Performing Structural or Equipment Welding and Cutting Operations

A. Work Order - Applications

1. Fabricate or repair tubing systems

UNIT MODULE TASK (Continued)

2. Reconstruct and align frames or related equipment
3. Fabricate protective devices for windows and openings
4. Fabricate metal reinforcing devices for structural foundations
5. Fabricate metal work stands or furniture
6. Fabricate or construct storage devices

B. Work Order - Advanced Applications

1. Fabricate aluminum structures or devices
2. Fabricate corrosion resistant steel
3. Prepare and weld pipe joints

VIII. Welder Certification Test

A. Procedure

1. Preparation for testing
2. Plate test
3. Pipe test

IX. Supervision, Training, and Job Estimating

A. Job Estimating

1. Estimate labor and materials costs of new fabrication
2. Estimate cost of repairs

B. Training

1. Write performance standards for jobs
2. Plan and conduct on-the-job training for employees
3. Conduct oral safety briefings
4. Improve work methods

C. Supervision

1. Plan and schedule work assignments
2. Assign work to others
3. Prepare annual shop budget
4. Receive and record new shipment of supplies
5. Interview job applicants
6. Prepare accident report

UNIT A

EMPLOYMENT OPPORTUNITIES

Terminal Objectives

Upon completion of the modules in this unit, you will:

- Know where and how to look for a job.
- Write a personal data sheet (resume).
- Complete a job application form.
- Be prepared for a job interview.

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Student Competency Sheet

Unit A: EMPLOYMENT OPPORTUNITIES

Task 1: LOOK FOR A JOB

Performance Checklist

1. Check the Dictionary of Occupational Titles for occupational titles in welding that interest you.
2. Check the Occupational Outlook Handbook for information relating to each of these jobs.
3. Consult the local telephone book for companies that hire employees under the job titles that interest you.
4. Make a list of the employers' names, addresses, and telephone numbers.
5. Look in the Classified Ads section of local, regional, and statewide newspapers for employers that are looking for employees with job titles that interest you.
6. Make an appointment with the school placement officer (if one is available) or the guidance person in charge of job placement. Find out what jobs are available on the local, regional, state, and national level. (Find out also what degree of training and experience is usually required for these jobs. Discuss with the counselor the possibilities for additional training after high school; schools that offer courses or programs you are interested in; possibilities for financial aid; and how to apply for financial aid.)
7. Visit local employers and find out what the working conditions are, distance needed to travel, employee benefits, competencies needed, and salary for the job you are interested in.

Test

Items Needed:

1. What Color Is Your Parachute?, Bolles, Penn Speed Press
2. Dictionary of Occupational Titles, U.S. Department of Labor, Employment and Training Administration
3. Occupational Outlook Handbook, U.S. Department of Labor, Bureau of Labor Statistics
4. Local, regional, and statewide newspapers
5. Telephone directories (Yellow Pages)
6. Paper and pencil
7. Local employers
8. Guidance counselor

Task: Research the employment opportunities in welding and related occupations.

Standard:

1. Must be able to identify several (at least three) jobs that interest you.
2. Must be able to describe the responsibilities of the welder.
3. Must be aware of the employment market for jobs that interest you.
4. Must be able to match competencies you have developed with those necessary to obtain a job or jobs that interest you.

Learning Activities

1. Read What Color Is Your Parachute?

2. See and participate in Units IX and X, "Job-Seeking Skills," Job Survival Skills Program. (Singer, 1973)

3. Read Information Sheet A-1. Then:

   a. Find other job descriptions about welding jobs in the Dictionary of Occupational Titles. (D.O.T. codes 810 through 819.887)
   b. Copy the descriptions of at least three that interest you.
   c. Discuss the jobs with your instructor and class: what skills (competencies) are needed? What are the local employment possibilities?

4. Attend a lecture-discussion on opportunities in welding.

   a. Talk about the major kinds of welding.
   b. Make a list of the kinds of welding that interest you.

5. Write separate lists of:

   a. Things you like to do.
   b. Things you do not like to do.
   c. Things you feel you do well.
   d. Things other people have complimented you on.
   e. Equipment you can operate/use.
   f. Jobs you feel you would like to have.
   g. Places you would like to live and work.
   h. Your living expenses when you are working. (Be reasonable--"cut out the fat."
   i. Advantages and disadvantages of the welding jobs that interest you.

6. Read "Welders," Occupational Outlook Handbook. Check the Index for other related job titles. Discuss with your class.

   a. Nature of the work.
   b. Places of employment.

   c. Training, other qualifications, and advancement.
   d. Employment outlook.
   e. Earnings and working conditions.

7. Interview a person who is currently employed in a welding job that interests you.

8. Write a brief report about a person who is currently employed in a welding job that interests you.

9. Look for a job that interests you. (Use the Performance Checklist.)
   NOTE: When you are actually job-hunting, apply for jobs at as many companies as you can find. Don't stop with one and just hope." If only filing an application is involved, do several each day. If interviews are involved, you should do at least two a day.

10. Read one of the following:

    a. Chapter 38, General Office Practice, 3rd Ed. (Archer, Brecker, Frakes, and Stewart. McGraw-Hill Book Co., 1968).
    b. Part 49, General Business for Economic Understanding, 11th Ed. (DeBrum, Haines, Malsbary, Daughtrey. Southwestern Publishing Co., 1976).

11. See and participate in Unit X, Job Survival Skills Program.

Information Sheet A-1

LOOK FOR A JOB

Some Dictionary of Occupational Titles Job Descriptions

WELDER, COMBINATION (D.O.T. Classification - 819-384-010)

WELDS METAL COMPONENTS TOGETHER TO FABRICATE OR REPAIR PRODUCTS, SUCH AS MACHINE PARTS, PLANT EQUIPMENT, MOBILE HOMES, MOTORS, AND GENERATORS, ACCORDING TO LAYOUTS, BLUEPRINTS, OR WORK ORDERS, USING BRAZING AND VARIETY OF ARC AND GAS WELDING EQUIPMENT:

Welds metal parts together, using both gas welding (WELDER, GAS) or brazing processes (WELDER, ARC).

Performs related tasks, such as thermal cutting and grinding.

Repairs broken or cracked parts, fills holes, and increases size of metal parts.

Positions and clamps together components of fabricated metal products preparatory to welding.

May locate and repair cracks in industrial engine cylinder heads, using inspection equipment and gas torch, and be designated REPAIRER, CYLINDER HEADS.

May perform repairs only, and be designated WELDER, REPAIR.

May be required to pass employer performance tests or standard tests to meet certification standards of governmental agencies or professional and technical associations.

WELDER, PRODUCTION LINE (D.O.T. Classification - 819-684-010)

WELDS METAL PARTS ON PRODUCTION LINE, USING PREVIOUSLY SET UP GAS OR ARC WELDING EQUIPMENT:

Turns valves to release fuel gas and oxygen and ignites mixture, or inserts specified weld rod into portable holder, clamps cable onto workpiece of jig, and strikes arc.

Guides electrodes, or torch and filler rod, along horizontal weld line at specified speed and angle to melt and deposit metal from filler rod or electrode onto workpiece.

Information Sheet A-1 (Continued)

May skip (tack) weld designated spots to secure workpieces for other welders.

May use different equipment and be designated as BRAZER, PRODUCTION LINE; WELDER, PRODUCTION LINE, ARC; PRODUCTION LINE, COMBINATION; WELDER, PRODUCTION LINE, GAS.

Student Competency Sheet

Unit A: EMPLOYMENT OPPORTUNITIES

Task 2: WRITE A PERSONAL DATA SHEET (RESUME)

Performance Checklist

1. Gather all the important information about you in the following areas:
   a. Education you have had.
   b. Work experience you have had.
   c. Your accomplishments or honors.
   d. Relevant personal information.
   e. Names of people who know what type of person you are.
2. Assemble this information in outline form as follows:
   a. Personal information
      Name, address, telephone number, year of birth, health.
   b. Education and Training
      Name and address of high school, grade level completed, work-related subjects completed. If your instructor maintains a list of competencies you have mastered, include the information that such a list is available to your prospective employer.
   c. Military Service
      Branch of U.S. Military Service, rank at time of discharge, type of duty assignments.
   d. Employment (Work Experience)
      List in order, beginning with the most recent and going back to your first employment. List: employer, dates, job title, duties, salary, supervisor, and reason for leaving. Include work done on a co-op or on a volunteer basis. Briefly describe your duties for each job.
   e. Awards, Licenses, Honors, and Organizations
      Include any honors or offices held during school years in VICA or other club activities.
   f. Interests and hobbies
   g. Personal References
      Names, addresses, and telephone numbers of three people you feel would recommend you for employment.
      NOTE: Always ask the person first before using someone's name.

Test

Items Needed:
1. Paper
2. Pen or pencil
3. Typewriter (recommended)

Task:	Organize personal information about yourself to write a personal data sheet (sometimes called a "resume").
Standard:	1. The personal data sheet will be complete. 2. The personal data sheet will be written in a neat, orderly fashion (typewritten if possible).

Learning Activities

1. If you do not already have a social security card, ask the school guidance counselor or placement officer how you can get one.

2. Develop a personal data sheet (resume) by following the steps outlined in the Performance Checklist:

   a. Use Information Sheet A-2 ("Write a Personal Data Sheet") as a guide to assemble information, then
   b. Write (neatly in pen) or type a personal data sheet (resume). You may use Information Sheet A-2a as a guide.

3. Read page 585, General Business for Economic Understanding, 11th Ed. (DeBrum, Haines, Malsbary, Daughtrey. Southwestern Publishing Co., 1976).

4. See and participate in Unit XI, "Resume," of Job Survival Skills Program. (Singer, 1973)

Information Sheet A-2

WRITE A PERSONAL DATA SHEET (RESUME)
(Collect Information About Yourself)

Name ____________________
(First) (Middle) (Last)

Address ____________________
(Street) (City) (State) (ZIP)

Telephone ____________________

Date of Birth ____________ Weight ________ Height ________

General Health ____________________

Job Objective (State clearly the kind of position, program, or area you are interested in.) ____________________

____

Elementary School Attended ____________ Dates ________

Junior High School Attended ____________ Dates ________

High School Attended ____________________

Major ____________ Year of Graduation ________

Technical Skills ____________________

____

Leadership Activities (Honors, Awards, Organizations, Licenses, etc.)

____

____

Work Experience (Briefly list jobs held, employers' names and addresses, length of service for each, brief description of duties, salary, supervisor, and reason for leaving. Include volunteer work.)

____

____

____

Information Sheet A-2 (Continued)

Interests and Hobbies ______________________________

____

References (Get permission to use names. Try to include people in business, in education, and a personal reference.) List name, address, telephone number.

1. ______________________________

2. ______________________________

3. ______________________________

Information Sheet A-2a

PERSONAL DATA SHEET

ROBERT M. JOBSEEKER

Personal Data:

Address:
124 Main Street
Charleston, West Virginia 25000

Telephone: (304) 123-4567

Date of Birth: August 28, 1961

Physical Condition: Excellent. Height--5' 11"; Weight--185

Job Objective:

Maintenance Welder in coal mining industry, utilizing oxyacetylene gas welding equipment.

Education:

Thomas Jefferson High School 124 Independence Avenue Charleston, West Virginia 25000	Graduated 1979. Vocational education: Two years (completion) of Welding program at John Quincy Adams Vocational Center
James Madison Junior High School 248 Independence Avenue Charleston, West Virginia 25000	Attended 1973-1976
James Monroe Elementary School 490 Independence Avenue Charleston, West Virginia 25000	Attended 1967-1973

Work Experience:

Employer:
Nationwide Welding
489 Revolutionary Street
Charleston, West Virginia 25000

Dates: June, 1979 - September, 1979 (part-time)

Job Title: Assistant Custodian

Information Sheet A-2a (Continued)

ROBERT M. JOBSEEKER
Page two

Work Experience (continued)

Duties:	Assisting with shop clean-up work, receiving shipments of stock and materials, storing stock and materials, locating and distributing stock and materials to personnel.
Salary:	$3.10 per hour
Supervisor:	Mr. Harry Truemann
Reason for Leaving:	Reduction in work force at company; seeking full-time welding position.

Awards, Licenses, Honors, and Organizations:

Holder of West Virginia Welder Certification, Flat Plate
Vocational Industrial Clubs of America (VICA):
    Chapter Reporter (1978-79)
    Participant, State Leadership Workshop (1979)
    House of Delegates, State Leadership Conference (1978)
    Third place winner, Welding, District Leadership Conference (1979)
Student Council Representative--James Madison Junior High School (1975-76)

Interests and Hobbies:

Ornamental Ironworking, Swimming, Bowling

References:

Mr. Harry Truemann
Shop Foreman
Nationwide Welding
489 Revolutionary Street
Charleston, West Virginia 25000 (304-347-0000)

Information Sheet A-2a (Continued)

ROBERT M. JOBSEEKER
Page three

References (continued)

Mr. Richard Nickson
Welding Instructor
John Quincy Adams Vocational Center
111 Mt. Vernon Road
Charleston, West Virginia 25000 (304-000-3470)

Mr. Lyndon Jackson
(Welder, Nationwide Welding)
126 Main Street
Charleston, West Virginia 25000 (304-123-3456)

Student Competency Sheet

Unit A: EMPLOYMENT OPPORTUNITIES

Task 3: COMPLETE A JOB APPLICATION FORM

Performance Checklist

1. Read the application form carefully before filling it out.
2. Refer to your Personal Data Sheet (resume). Fill out all the blanks as they apply to you.
3. Draw a short line in the blanks that do not apply, or write N/A (not applicable).
4. Either print or write, as directed. (NOTE: Never use both.)
5. Use either a pen or a clear-writing pencil. (NOTE: Never use both.)
6. Do not use abbreviations.
7. Be neat, accurate, and honest with all information.
8. Always write your signature.
9. Do not write in the blanks that are to be used by the company.

Test

Items Needed:
1. Your Personal Data Sheet
2. Job application form
3. Ballpoint pen or pencil

Task: Complete the application form.

Standard:
1. The directions printed on the application form will be completed with 100% accuracy.
2. All information filled in on the application will be spelled correctly.
3. The completed application will be neat.
4. The completed application must be approved by your instructor.

Learning Activities

1. Obtain a job application form from your instructor. Locate the following spaces on the job application form:

   a. Personal Data
      (1) Date of Birth (DOB)
      (2) Place of Birth (POB)
      (3) Social Security Number (SSN)
      (4) Telephone number, including area code
      (5) Residence, including ZIP code
      (6) Marital status (if listed)
      (7) Picture (if requested)

- b. Educational Information
    - (1) High school credits
    - (2) Courses taken
    - (3) Class rank
    - (4) Co-curricular activities
    - (5) Extra-curricular activities
    - (6) Special awards and recognitions
- c. Military Information
- d. Previous Employment

2. Read and learn the terms listed on Information Sheet A-3 ("Terms to Know to Fill Out a Job Application").

    a. Discuss these terms with your class.
    b. Discuss these items with your instructor and class. Do any of them violate Civil Rights legislation?

3. Take the self-check test supplied by your instructor. (See Self-Check Test A-3.)

4. Practice completing an application for employment (obtain from your instructor).

5. Fill out a different application form provided by your instructor or an employer. Use the Performance Checklist whenever needed.

6. See and participate in Unit XII, "Packaging Your Skills: Application" in Job Survival Skills Program, Singer Career Systems, Rochester, NY, 1973.

7. Read: Pages 585-588, General Business for Economic Understanding, 11th Ed. (DeBrum, Haines, Malsbary, Daughtrey. Southwestern Publishing Co., 1976), or pages 522-523, General Office Practice, 3rd Ed. (Archer, Brecker, Frakes, Stewart. McGraw-Hill Book Company, 1968).

Information Sheet A-3

TERMS TO KNOW TO FILL OUT A JOB APPLICATION

1. Nationality - country where a person is born.
2. Guardian - person in charge of the legal care of a youth.
3. Number of dependents - individuals who depend upon you for their support.
4. Ethnic group - caucasian (white), negroid (black), Indian, Asian, or other.
5. Limitations - health or physical condition that may hinder a person on the job.
6. Capabilities - things you can do well.
7. Compensation - pay for time not able to work.
8. Naturalized citizen - a person who has gone through the legal process to become a U.S. citizen.
9. Natural born citizen - a person who is born in a country.
10. Fringe benefits - things given an employee other than money.
11. Wage - the hourly rate of pay.
12. Salary - monthly or yearly contract payments.
13. Supervisor - a person who works for another person or company.
14. Employee - a person who works for another person or company.
15. Employer - a person or company who hires another.
16. O.A.S.I. - Old Age Survivors Insurance.
17. Deduction - that which is taken from a pay check.
18. Federal withholding - tax money taken out for the U.S. Government.
19. State withholding - tax money taken out by the State Government.
20. Annuity - a form of saving money.
21. Gross Pay - the total amount paid before deductions.
22. Take home pay - the amount that is taken home.
23. Management - those who make decisions.
24. Personnel Manager - person who is in charge of people.
25. Job interview - the person-to-person contact between employee and employer.
26. F.I.C.A. - (Federal Insurance Compensation Act) - money taken out for Social Security.

SELF-CHECK TEST
A-3

Define the following terms:

1. Nationality - ______________________________
2. Guardian - ______________________________
3. Number of dependents - ______________________________
4. Ethnic group - ______________________________
5. Limitations - ______________________________
6. Capabilities - ______________________________
7. Compensation - ______________________________
8. Naturalized citizen - ______________________________
9. Natural born citizen - ______________________________
10. Fringe benefits - ______________________________
11. Wage - ______________________________
12. Salary - ______________________________
13. Supervisor - ______________________________
14. Employee - ______________________________
15. Employer - ______________________________
16. O.A.S.I. - ______________________________
17. Deduction - ______________________________
18. Federal withholding - ______________________________
19. State withholding - ______________________________
20. Annuity - ______________________________
21. Gross Pay - ______________________________
22. Take home pay - ______________________________
23. Management - ______________________________
24. Personnel Manager - ______________________________
25. Job interview - ______________________________
26. F.I.C.A. - ______________________________

Student Competency Sheet

Unit A: EMPLOYMENT OPPORTUNITIES

Task 4: PREPARE FOR A JOB INTERVIEW

Performance Checklist

1. Write a letter of application and ask for an interview. Or, go directly to the employer and ask for an interview.
2. Secure as much information as possible about the company and its services before the interview. Know what is made or sold, how large the business is, how many locations there are, kinds of jobs available, and qualifications necessary to perform them.
3. Get a good night's sleep before the interview.
4. Before going to the interview, make sure you have taken a shower or bath, brushed your teeth, combed your hair, and put on clean, neat clothes.
5. Be prompt for the interview.
6. Go alone.
7. Look pleasant.
8. Introduce yourself in a quiet, pleasant way.
9. Shake hands firmly.
10. Sit erect (if the prospective employer indicates that you should sit down).
11. Avoid signs of nervousness (such as tapping fingers or foot).
12. Look the interviewer in the eye.
13. Be ready to describe your competencies and qualifications to the interviewer.
14. Be ready to take a performance test if the job requires it.
15. Leave discussion of salary to the end of the interview.
16. Thank the interviewer before you leave.
17. Every interview should be followed up with a letter of appreciation.

Test

Items Needed:
1. An employer (either an actual prospective employer or another student who will act as interviewer)
2. List of competencies you have developed (or a simulated list)
3. Pen
4. List of questions to ask, things to remember at the interview

Task:
1. Prepare for a job interview.
2. Have a job interview (by a prospective employer or another student).

Standard: Your instructor will evaluate your preparation and performance.

Learning Activities

1. Complete the Pretest (Self-Check Test A-4).
2. Read one of the following:
    a. Page 588, General Business for Economic Understanding, 11th Ed.
    b. Pages 519-521, General Office Practice, 3rd. Ed.
3. Write a letter of application. (See Information Sheet A-4.)
4. See and participate in Unit XIII, "Interview," Job Survival Skills Program.
5. Develop a list of welding competencies you have mastered.
6. Read and discuss the Information Sheets for this task:
    a. "Interviewing: A Skill, Not a Mystery" (Information Sheet A-4a)
    b. "Some Frequently Asked Questions During the Interview" (Information Sheet A-4b)
    c. "Things to Remember at the Interview" (Information Sheet A-4c)
    d. "Factors Which Frequently Lead to Rejection of the Applicant" (Information Sheet A-4d)
7. Before going to the interview, develop a check list of things to ask.
8. Discuss, with instructor and class, how to handle an interviewer's questions that violate civil rights. (For example, "What church do you attend?")
9. Develop a list of things to remember to tell about yourself at the interview. (Keep this in a coat pocket or wallet, but use it only when needed.)
10. Complete "Check List to be Used Before Going for an Interview" (Information Sheet A-4e).
11. Practice with another student: take turns being the interviewer and the applicant. Use the Performance Checklist as a guide.

SELF-CHECK TEST
A-4

Pretest*

1. Prior to an interview, a well-prepared applicant should:
   - a. Rely on memory to answer or fill out any questions.
   - b. Be prepared to answer questions by composing his own questions and answers.
   - c. Answer all questions "off the top of the head."

2. For the interview, an applicant should:
   - a. Wait for the interviewer to explain what the company's business is.
   - b. Not worry about the company and just interest himself/herself in a specific job.
   - c. Research the company.

3. In preparation for the interview, an applicant should:
   - a. Locate the company prior to the interview.
   - b. Leave early enough to find the company on the day of the interview.

4. Appropriate dress for an interview might be:
   - a. Blue jeans and a shirt.
   - b. Your best dress-up clothes.
   - c. Clean, neat clothes appropriate to the company and the job you're applying for.

5. When an interview is scheduled for 10:00 a.m., the applicant should:
   - a. Not worry about being ten (10) minutes late.
   - b. Be punctual.
   - c. Arrive an hour early.

6. When speaking with the interviewer, an applicant should:
   - a. Emphasize good points.
   - b. Tell the interviewer he/she didn't do so well in some skills or courses.
   - c. Avoid the whole truth.

7. To answer any questions an interviewer might ask, an applicant should:
   - a. Be honest, factual, and sincere.
   - b. Make up something if he/she doesn't know the answer.
   - c. Lie if necessary to make a good impression.

8. If asked, "What can you do?" an applicant should:
   - a. Avoid saying, "I'll do anything."
   - b. Tell the interviewer, "It depends."
   - c. Say, "I'll do anything."

Self-Check Test (Continued)

9. When speaking to an interviewer, an applicant should:
   a. Try to look the interviewer in the eye.
   b. Read the pre-written paper.
   c. Look around the room.

10. An appropriate response to end an interview might be:
   a. "Thank you."
   b. "See you later."
   c. "Please pick me."

11. If an applicant never hears from the company, he/she should:
   a. Never apply for another job.
   b. Tell friends never to apply there.
   c. Not be discouraged.

12. If an applicant doesn't get the job, he/she should:
   a. Analyze why.
   b. Forget about the interview.
   c. Blame it on the interviewer.

13. If an applicant doesn't get the job, he/she should:
   a. Mourn.
   b. Keep trying.
   c. Be content to be unemployed.

*No answers are provided for this pretest. Instead, use each item as a discussion item with your instructor and class. Also, look for the correct answers as you complete the other Learning Activities for this task.

Information Sheet A-4

124 Main Street
Charleston, West Virginia 25000
September 10, 19__

Mr. James Polk
Personnel Director
Ace Manufacturing
253 Brownlee Road
Charleston, West Virginia 25003

Dear Mr. Polk:

In response to your ad for Welders in the Sunday, September 9, 19__, edition of The Charleston Post, I am enclosing a resume.

I have recently completed the two-year welding program at John Quincy Adams Vocational Center, where I satisfactorily completed all the required competencies for this program.

My experiences in school and in the custodial position at Benjamin Franklin Art Welding will indicate to you that I am very much interested in a career in welding. You will note also that I have had a great deal of leadership experience through VICA, which will indicate both my interest in welding and potential to be an asset to your company.

I would appreciate your consideration of me as a member of your firm. I can be contacted for an interview at 123-4567.

Thank you very much.

Sincerely,

Michael J. Jobseeker

Enclosure

Information Sheet A-4a

INTERVIEWING: A SKILL, NOT A MYSTERY*

I. GETTING READY FOR AN INTERVIEW

1. Figure out what you really want to do. Be specific. Make a list of exactly what you want AND of what you don't want. Look at what you've done in the past--education, summer jobs, hobbies, clubs, etc. Get help from your counselor. You've got to have some idea of what you're after.

2. Learn everything you can about the company. Read any literature you can find to learn about job openings and what they are like, company benefits, etc. Talk to people who work or have worked for the company. The more you know before the interview, the fewer unnecessary questions you'll have to ask--and the interviewer is bound to be impressed if you've "done your homework."

3. Role-play an interview with a friend, taking turns as interviewer and applicant. This way you'll know the routine of an interview and will be more relaxed when it's for real. Talk to others who have been interviewed (by the company you're applying to if possible).

4. Be fair to yourself--be sure the interviewer knows all about you and what you can do. This means learning to fill out job applications correctly. DON'T give incomplete answers. DON'T fill out the application hurriedly--be sure it's neat and written as clearly as you can. Print everything but your signature. You'll do a better job of giving all the information about yourself if you take along your Personal Data Sheet (Resume). (Some companies use an information form similar to the Personal Data Sheet in addition to the job application form.) Take along a competency record that shows the skills you have mastered.

II. WHAT INTERVIEWERS LOOK FOR

1. An interview is short. The interviewer must learn a lot about you in a very short time. The basic purpose of the interview is to exchange enough information to screen you from a number of other applicants. They have to decide whether the company should talk with you further and keep your name on the applicant list.

Information Sheet A-4a (Continued)

2. First impressions will be noted. The interviewer usually makes notes of the first impression, so making a good first impression is an asset to you and to the company you'd like to work for. During the interview, other general traits will also be noted: poise, ability to communicate, social skills, and personality. In short, the interviewer only sees you once and the impression you leave is what the interviewer sees as a general picture of you.

3. An interviewer wants to find out exactly what you think you want and why, what kind of work you're looking for, and how interested you are in that work. Interviewers also look for career goals, drive to accomplish those goals, interest in further education, further training, and such other things as preferred location and your willingness to relocate if necessary.

4. The purpose of telling the interviewer what you've done is to help indicate if your work interests seem to match your talents. Your qualifications will be reviewed: jobs, grades, skill level, special training, hobbies, and extracurricular activities.

5. If you do seem qualified for a certain kind of work, the interviewer has to see if the company has a job area that might match your interests. If so, they'll explain the details of the work and see if you are interested and just how interested.

III. HOW TO ACT DURING AN INTERVIEW

1. Be yourself. DON'T "act." The only company you are likely to be happy working for is one that likes you just the way you are. Very few people can play roles well enough to fool an interviewer, who has met and talked to a great many people.

2. Don't overdo it. Act professionally and naturally. Be on time! Be friendly, but not too casual. Be courteous. Have your thoughts and questions well organized.

3. Don't be afraid to tell the interviewer all about yourself. Don't answer questions with just a yes or no. Take this opportunity to tell about your goals and strong points. This may alert an interviewer to terrific information about you that didn't show up on the resume. Open up!

Information Sheet A-4a (Continued)

4. Tell it like it is. A lie is often an attempt to hide a problem that will only get in the way later. Be completely honest. If you have no interest in a particular kind of work or job, say so. You should be trying to screen the company too.

IV. WHAT TO EXPECT AFTER AN INTERVIEW

1. Don't expect to be hired on the spot. It's usually not the role of the interviewer to do the hiring. Interviewers only make screening decisions to determine whether the company should talk with an applicant further. By the end of the interview, most companies will try to tell you as clearly as possible what to expect next.

2. Interviewers rarely promise anything, even when they think the applicant is highly qualified. But if they feel you'll be under active consideration, they'll usually indicate that you can expect a second interview or that they'll contact you later.

3. Write to the interviewer after the interview if you're interested. Mention the interviewer's name, time, and date of the original interview, plus important points discussed. If it's a small company, especially, and you haven't heard anything in a week, call back. Sometimes applications get moved to the bottom of the stack. Remind the interviewer of your interest. Keep on learning about the company.

4. If you get a "NO" answer, it's probably because your interests and the company's don't match. Don't worry, just analyze "why." Almost everyone hears a "no" before a job is landed. Look at it as a learning experience: you've learned about interviewing, about your likes, a company's needs, and you've got great experience to go ahead to another company much better suited to you.

*Adapted from "What Students Should Know About Interviewing," General Electric, Educational Communications Programs, Fairfield, CT 06431, 1978.

Information Sheet A-4b

SOME FREQUENTLY ASKED QUESTIONS DURING THE INTERVIEW*

1. What are your future vocational plans?
2. In what school activities have you participated?
3. How do you spend your spare time? What are your hobbies?
4. In what type of position are you most interested?
5. Why do you think you might like to work at our company?
6. What jobs have you held? Why did you leave?
7. What course did you like best in school? Least? Why?
8. What do you know about our company?
9. Do you feel that you have received good general training?
10. Why do you feel that you will be successful in your field?
11. What extracurricular offices have you held?
12. What are your ideas on salary?
13. Do you prefer any specific geographic location? Why?
14. How much money do you expect to earn at the age of 20? 35?
15. How did you rank in school?
16. Do you think that your extracurricular activities were worth the time devoted to them?
17. What personal characteristics are necessary for success in your field?
18. What is your father's occupation?
19. Are you looking for a permanent or temporary job?
20. Do you prefer working alone or with others?
21. Can you take instructions without feeling upset?
22. Tell me a story.
23. Are you primarily interested in making money or do you feel that service to your fellowmen is satisfactory pay?
24. Do you live with your parents?
25. Can you get recommendations from previous employers?
26. What interests you about our products and services?
27. Do you feel you have done the best scholastic work of which you are capable?
28. How long do you expect to work?

Information Sheet A-4b (Continued)

29. Have you ever had any trouble getting along with fellow students?
30. Have you saved any money?
31. Do you have any debts?
32. Do you attend a church?
33. Do you like routine work?
34. What size city do you prefer?
35. What is your major weakness?
36. Will you work hard to get ahead?
37. Are you eager to please?
38. What do you do to get in good physical condition?
39. Have you had serious illnesses or injuries?
40. Are you willing to relocate if the company wishes?
41. What job in the company would you like most to have?
42. Is it difficult for you to get along with people who have different backgrounds and interests than you?
43. Do you use liquor? How much?
44. Should an employer consider your grades? Why?
45. Would you be willing to work overtime? How much?
46. Do you possess any special skills or abilities?
47. What have you done that indicates initiative and a desire to work?
48. You have a complaint about your job or working conditions. How would you handle it?
49. You and a fellow worker are having differences about your jobs. What would you do?
50. You have an idea you feel will help the company. What would you do?

*Courtesy of the Virginia Polytechnic Institute and State University Agriculture Education Department, Blacksburg, Virginia, in cooperation with the Agriculture Education Service, Division of Vocational Education - State Department of Education, Richmond, Virginia.

Information Sheet A-4c

THINGS TO REMEMBER AT THE INTERVIEW*

1. Sit up straight.
2. Speak in a quiet, pleasant voice.
3. Try to answer all questions correctly.
4. Never talk about personal problems.
5. Be respectful.
6. Use your best English at all times.
7. Know or write down the questions you wish to ask during the interview.
8. Never smoke or chew gum during the interview.
9. Inquire as to what follow-up procedure is required.
10. School subjects you liked best, extracurricular activities.
11. Your educational plans.
12. Ask some questions about the firm.
13. If you've ever been employed, be able to list employer, name of firm, date employed, address, salary, and reason for leaving.

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*Courtesy of the Virginia Polytechnic Institute and State University, Agriculture Education Department, Blacksburg, Virginia, in cooperation with the Agriculture Education - State Department of Vocational Education, Richmond, Virginia.

Information Sheet A-4d

FACTORS WHICH FREQUENTLY LEAD TO REJECTION DURING THE JOB INTERVIEW

In the 1969 survey by Penn Tech Institute (Pittsburgh, Pennsylvania), the following factors were reported by 153 companies as having led to the rejection of the applicant during the employment interview.

1. Poor personal appearance.
2. Overbearing - overaggressive - conceited "Superiority complex" - "know-it all."
3. Inability to express himself/herself clearly - poor voice, diction, grammar.
4. Lack of planning for career - no purpose and goals.
5. Lack of confidence and poise - nervousness - ill-at-ease.
6. Lack of interest and enthusiasm - passive, indifferent.
7. Failure to participate in activities.
8. Overemphasis on money - interested only in best dollar offer.
9. Poor scholastic record - just got by.
10. Unwilling to start at the bottom - expects too much too soon.
11. Makes excuses - evasiveness - hedges on unfavorable factors in record.
12. Lack of tact.
13. Lack of maturity.
14. Lack of courtesy, ill-tempered.
15. Condemnation of past employers.
16. Lack of social understanding.
17. Marked dislike for school work.
18. Lack of vitality.
19. Fails to look interviewer in eye.
20. Limpy, fishy hand-shake.
21. Indecision.
22. Loafs during vacations - lakeside pleasures.
23. Unhappy married life.
24. Friction with parents.
25. Sloppy application blank.
26. Merely shopping around.
27. Wants job only for short time.
28. Little sense of humor.
29. Lack of knowledge in field of specialization.
30. Parents make decisions for him/her.
31. No interest in company, or in industry.
32. Emphasis on whom he/she knows.
33. Unwillingness to go where we send him/her.
34. Cynical.
35. Low moral standards.
36. Lazy.
37. Intolerant - strong prejudices.
38. Narrow interests.
39. Spends too much time in movies.
40. Poor handling of personal finances.
41. No interest in community affairs.
42. Inability to take criticism.
43. Lack of appreciation of value of experience.
44. Radical ideas.
45. Late to interview without good reason.
46. Never heard of company.
47. Failure to express appreciation for interviewer's time.
48. Asks no questions about the job.
49. High pressure type.
50. Indefinite response to questions.

Information Sheet A-4e

CHECK LIST TO BE USED BEFORE GOING FOR AN INTERVIEW*

	Yes	No
1. Did I plan ahead for the interview?		
2. Am I nervous when I meet people?		
3. Do I ask intelligent questions?		
4. Do I become tense when asked questions?		
5. Am I highly emotional?		
6. Do I take pride in my appearance?		
7. Do I listen when someone else is talking?		
8. Do I look at the speaker?		
9. Do I practice good posture?		
10. Do I use proper English?		
11. Do I think before answering?		
12. Do I answer honestly?		

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*Check list courtesy of the Virginia Polytechnic Institute and State University, Agriculture Education Department, Blacksburg, Virginia, in cooperation with the Agriculture Education Service, Division of Vocational Education, State Department of Education, Richmond, Virginia.

UNIT B

HUMAN RELATIONS

Terminal Objectives

Upon completion of the modules in this unit, you will:

- Understand your personality and needs.
- Understand the principles involved in successful work attitudes.
- Be able to influence the behavior of others by successful use of motivating factors.

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Student Competency Sheet

Unit B: HUMAN RELATIONS

Task 1: UNDERSTAND YOURSELF

Performance Checklist

1. Analyze yourself (interests, aptitudes, abilities, personality traits).
2. Analyze your needs (personal, financial).
3. Explore possible careers which will match your personal characteristics and your needs.
4. Set a career goal.
5. Establish short term goals that will help you reach your career goal.

Test

Items Needed:
1. Paper
2. Pen or pencil
3. Envelope

Test:
1. Demonstrate that you understand yourself--your personality and needs.
2. Demonstrate that you can relate knowledge of yourself to career plans.

Standard:
1. Your evaluation of your personality traits, as shown by you on the Personality Rating Sheet (Information Sheet B-1) will include a plan to improve any traits rated as "Fair," "Poor," or "Very Poor."
2. You will correctly answer ten (10) of the twelve (12) questions on the test for this task.

Learning Activities

1. Read pp. 81-94, Succeeding in the World of Work (Kimbrell and Vineyard. McKnight Publishing Co., 1975).
    a. Make a vocabulary list of new words.
    b. Learn what these words mean.
    c. Discuss the meaning of the words with several classmates.

2. Rate your own personality, using the "Personality Rating Sheet" (Information Sheet B-1).

    a. List your personality traits which need improvement (anything not rated as "Good" or "Excellent"). Try to be honest and objective. (Most of us can use some improvement.)
    b. You may discuss your goals with your instructor to get helpful suggestions for improvement of personality traits which may affect your career plans.
    c. Write your plan for improving any areas not rated as "Good" or "Excellent."
    d. Obtain an envelope from your instructor. Place your evaluation in the envelope. It will be placed in your folder. At the end of the semester, get this envelope and rate yourself again. Note the improvements.

3. See and participate in the following units of Job Survival Skills Program:

    a. Unit I, "Introduction"
    b. Unit II, "Educational and Training"
    c. Unit IV, "Self-Concept and Employment"

4. Read pages 95-96, Succeeding in the World of Work. Write a separate paper on each of the following words. Tell what the words mean to you and your personality.

    a. Parental pressure, teacher pressure, and peer pressure
    b. Economic resources
    c. Marital status
    d. Chance
    e. Self-concept

5. Submit each of the above papers to your instructor. Discuss them with the instructor.

6. With the help of your instructor and classmates, review the jobs you were interested in (Unit A, Task 1).

    a. Identify the job area for which you are probably best suited.
    b. List areas of your personality you will need to develop in order to perform your chosen job.
    c. Discuss with your instructor and classmates how these personality factors (traits) are important in performing the daily requirements of your chosen job.

7. Use the job(s) selected in Activity 6 as the first step toward meeting your career goal.

    a. Discuss your career goal with your instructor. Explore your personal needs and the requirements for reaching your goal.

b. Discuss what you can do to
   (1) fulfill these needs and
   (2) meet the requirements of the job you would like to have and to reach your career goal.

8. Take the written test for this task. You may not use references.

Information Sheet B-1

SELF-RATING YOUR PERSONALITY

Rate your own personality according to traits which make up your personality. Use the chart below. (You may add others you feel are important.)

PERSONALITY RATING

Trait	Excellent	Good	Fair	Poor	Very Poor
ATTITUDE					
COURTESY					
DEPENDABILITY					
DESIRE TO SUCCEED					
ENTHUSIASM					
FORESIGHT					
FRIENDLINESS					
HEALTH					
HONESTY					
INITIATIVE					
LOYALTY					
MORALITY					
NEATNESS					
OPEN-MINDEDNESS					
PERSONAL APPEARANCE					
PUNCTUALITY					
SELF CONTROL					
SENSE OF HUMOR					
TACT					
USE OF VOICE					

Student Competency Sheet

Unit B: HUMAN RELATIONS

Task 2: UNDERSTAND SUCCESSFUL WORK ATTITUDES

Performance Checklist

1. Identify personal traits that affect your relationship with others.
2. Analyze how personal traits and attitudes of others affect you.
3. Analyze how your personal traits affect others.
4. Identify and analyze the ways the attitudes of others are influenced by your attitudes, traits, and habits.
5. Make a plan to upgrade your attitudes, traits, and habits.

Test

Items Needed:
1. Paper
2. Pencil or pen
3. Envelope

Task: Demonstrate your understanding of the principles involved in "successful work attitudes."

Standard:
1. Your instructor will evaluate your role-play performance of positive and negative attitudes. Your performance must show that you understand:
   a. Yourself in a given role.
   b. How your attitude reflects on your relationship with co-workers.
   c. How your attitude reflects on your relationship with your supervisors.
2. On the test for this task, you must answer twelve (12) of the fifteen (15) questions correctly.

Learning Activities

1. Read pages 50-61, Succeeding in the World of Work.

   a. List and define new terms.
   b. Discuss these terms and what they mean to you with your classmates.

2. Take the "5-Minute Timed Test on Following Directions." (Your instructor will supply the test.)

   a. Remember the terms "honesty" and "discipline": do not "clue" another student as to the content of this test.

3. Read and complete Information Sheet B-2, "Personality Rating."

    a. Put your completed rating sheet in an envelope and seal the envelope.
    b. Give the envelope to your instructor to keep until you have completed the activities for this task.

4. See and participate in the following units of Job Survival Skills Program:

    a. Unit VI, "You and Your Supervisor"
    b. Unit VII, "You and Your Co-Workers"
    c. Unit VIII, "Successful Job Behavior"

5. Participate in a class discussion on positive and negative attitudes:

    a. Role-play attitudes which have been identified by the group.
    b. How have the attitudes demonstrated in the role-play situation changed when the actors played the role of a new employee? an edlerly person? a handicapped person? a supervisor?
    c. Your instructor will evaluate your performance.

6. Take the written evaluation for this task. You must answer twelve (12) of the fifteen (15) questions correctly.

7. Your instructor will return the envelope which contains your self-rated "Personality Rating."

    a. Review your self-ratings. Rate yourself again. Have the ratings changed?
    b. Discuss with your instructor the ways you can improve your personality traits to be a more effective worker.

Information Sheet B-2

UNDERSTAND SUCCESSFUL WORK ATTITUDES

You have read about and discussed traits which make up personality and affect your relationships with others. These traits are very important. Rate your own personality according to the chart below.

PERSONALITY RATING

Trait	Excellent	Good	Fair	Poor	Very Poor
ATTITUDE					
COURTESY					
DEPENDABILITY					
DESIRE TO SUCCEED					
ENTHUSIASM					
FORESIGHT					
FRIENDLINESS					
HEALTH					
HONESTY					
INITIATIVE					
LOYALTY					
MORALITY					
NEATNESS					
OPEN-MINDEDNESS					
PERSONAL APPEARANCE					
PUNCTUALITY					
SELF CONTROL					
SENSE OF HUMOR					
TACT					
USE OF VOICE					

Student Competency Sheet

Unit B: HUMAN RELATIONS

Task 3: USE PRINCIPLES OF HUMAN RELATIONS

Performance Checklist

1. Make a list of things others do or attitudes they have that annoy you or that you find difficult to deal with.
2. Make a list of things you do or attitudes you may have that might annoy others or make others feel you are difficult to deal with.
3. Make a list of things you find pleasant in others.
4. Make a list of things others have found pleasant in you.
5. Review these lists to identify positive things about yourself that can influence others.
6. Analyze how the things you listed in #5 can affect your career goal.

Test

Items Needed:
1. Paper
2. Pen or pencil
3. Partner

Task: Demonstrate your understanding of:
- a. Some of the motivating factors which cause human beings to behave as they do, and
- b. Ways of influencing others to behave as you would like them to behave.

Standard:
1. Your instructor will evaluate your written and performance demonstrations of how well you understand and can cope with factors which motivate the way people behave.
2. Your instructor will evaluate the written test for this task. You must answer twelve (12) of the fifteen (15) questions correctly.

Learning Activities

1. Read pages 104-111, Succeeding in the World of Work.

   a. List and define new terms.

   b. Discuss these terms and what they mean to you with your classmates.

2. See and participate in the following units of Job Survival Skills Program:
    - a. Unit III, "From Which Point of View"
    - b. Unit V, "Communication"
    - c. Unit XIV, "Summarizing"
    - d. Unit XV, "Individual Assessment"

3. Write a paragraph discussing why human relationships are important to your career. Have your instructor evaluate your work.

4. With a fellow student, role-play a situation between a new employee and a supervisor or an experienced welder.
    - a. Have your instructor evaluate your behavior during the performance.
    - b. Have your classmates discuss their reactions to your performance.

5. Using the same student partner as in Learning Activity 4, describe in writing what message this person's body language conveyed to you during your demonstration.
    - a. Discuss your findings with your partner.

6. While you are in laboratory (shop) sessions, your instructor will evaluate your progress. Look at the "Performance Appraisal" example (Information Sheet B-3). Each area of your performance is rated: skill competence and personal effectiveness (how your actions affect others).
    - a. Discuss with your classmates how you can try to achieve personality performance skills that will help you earn the best ratings for each item on the form.

7. Take the written evaluation for this task. You must answer twelve (12) of the fifteen (15) questions correctly. (You may not use references.)

Information Sheet B-3

PERFORMANCE APPRAISAL

Name:____ Date:____________________

INSTRUCTIONS: This form should be used to evaluate employee performance. It should be reviewed with the employee. Place a check in the space which best expresses your judgment.

1.	QUALITY OF WORK	Unsatisfactory ( )	Satisfactory ( )	Above Average ( )
2.	QUANTITY OF WORK	Substandard ( )	Average ( )	High ( )
3.	POTENTIAL	Doubtful ( )	Promising ( )	Above Average ( )
4.	ATTITUDE	Indifferent ( )	Normal Interest ( )	Enthusiastic ( )
5.	COOPERATION WITH OTHERS	Antagonistic ( )	Satisfactory ( )	Supportive ( )
6.	JOB SKILL	Low ( )	Adequate ( )	Good ( )
7.	INITIATIVE	Needs Prodding ( )	Does Assigned Work Well ( )	Seeks Tasks to be done ( )
8.	ATTENDANCE	Unsatisfactory ( )	Satisfactory ( )	No. of days Present ( )
9.	APPEARANCE	Must Improve ( )	Satisfactory ( )	Outstanding ( )

COMMENTS ____

____

____

SIGNATURE OF IMMEDIATE SUPERVISOR________________ DATE________________

SIGNATURE OF EMPLOYEE RATED______________________ DATE________________

UNIT C

SAFETY

Terminal Objectives

Upon completion of the modules in this unit, you will know and practice the basic procedures that will:

. Maintain personal safety

. Maintain general shop safety

Student Competency Sheet

Unit C: SAFETY

Task 1: MAINTAIN PERSONAL SAFETY

Performance Checklist

1. Interpret local, state, and federal safety rules and regulations for welders.
2. Interpret federal safety color codes.
3. Identify potential safety hazards in your environment.
4. Locate fire extinguishers, first aid station, emergency exits, emergency stop bars, and other emergency safety features in your environment.
5. Practice personal safety precautions (clothing, work habits, etc.).
6. Locate emergency services (nurse, ambulance, fire company, etc.).
7. Practice correct "do's" and avoid the "don't's" for emergency situations (injury, heart attack, fire, etc.).

Test

Items Needed:
1. Notebook
2. Pencil
3. Local, state, and federal safety code books
4. Floor plans of school
5. Floor plan of shop, showing work stations and emergency/evacuation features
6. Soap and water
7. Safety glasses, goggles, helmets, safe clothing, safety equipment

Task:
1. Demonstrate knowledge of safety rules.
2. Demonstrate knowledge of safety precautions.
3. Demonstrate knowledge of emergency behavior.

Standard:
1. Correctly identify colors and applications designated by federal safety code.
2. Dress and grooming will promote safety.
3. Behavior will promote safety of self and others.
4. Correctly identify safety-emergency features of the shop.
5. Emergency procedures demonstrated are appropriate to the situation.

Learning Activities

1. Start a Safety Notebook. Take daily notes; enter them in sections marked:
    - a. Safety Codes
    - b. Personal Safety
    - c. General Shop Safety
    - d. Emergency Procedures
    - e, f, etc. To be added according to instructor's directions.

2. Read Vocational Trade and Industrial Education--Welding, pp. 5-A - 17-A.

3. With your class, review local, state, and federal safety rules/ regulations. Discuss:
    - a. How they are applied in your school.
    - b. How they affect local welders and the companies they work for.
    - c. Why they were developed; by whom; when.
    - d. Penalties for not complying with regulations.

4. With your instructor, tour your school to identify emergency features:
    - a. Locate nurse's office, emergency exits, telephones, fire extinguishers etc.
    - b. Mark and label the sites you identified on a floor plan of the school.
    - c. Learn and practice the school's emergency evacuation procedures.

5. With your instructor, tour your shop:
    - a. Locate:
        - (1) Hazardous areas/equipment
        - (2) Safe paths, safety features
        - (3) Emergency paths and exits
    - b. Identify and, if applicable, practice using items which are color-coded for safety.
    - c. Discuss dangerous areas.
    - d. Discuss dangerous shop practices.

6. Attend a lecture-demonstration on personal grooming.
    - a. Discuss how grooming is related to safety.
    - b. Practice the proper technique for washing with soap and water.

7. Attend a lecture-demonstration on:
    - a. Appropriate clothing.
    - b. Use and care of safety goggles and glasses.
    - c. Use and care of other safety equipment.

8. Demonstrate proper care and use of clothing and safety equipment.

9. Discuss how personal behavior in the shop/on the job affects your safety and that of others.

10. Invite the school nurse or a paramedic to speak to the class and to demonstrate emergency care and behavior.

    a. Practice the procedures demonstrated.
    b. Discuss situations where these procedures might be helpful; i.e., common shop accidents, heart failure, etc.

11. Write a plan for personal safety.

    a. Have your instructor check your plan.
    b. Compare your plan with those of other class members.

Student Competency Sheet

Unit C: SAFETY

Task 2: MAINTAIN GENERAL SHOP SAFETY

Performance Checklist

1. Interpret local, state, and federal safety rules and regulations for welding.
2. Interpret federal safety color codes.
3. Identify potential safety hazards in your environment.
4. Follow all general shop safety rules.
5. Follow all safety rules specific to your shop.
6. Maintain clean, orderly work area.
7. Identify type of emergency, should one occur; follow emergency plan.

Test

Items Needed:

1. Safety Notebook
2. Pencil
3. Local, state, and federal safety code books
4. Floor plan of shop
5. Fire extinguishers
6. OSHA "Safety and Health Standards Digest"
7. Written emergency procedure for shop

Task: Maintain safe working conditions in the shop.

Standard:

1. Maintain clean, neat work area.
2. Identify guards and safety devices.
3. Identify and operate disconnect switches/power plugs.
4. Identify cause of fire and use correct extinguishing method.
5. Follow shop procedures for reporting accidents, faulty equipment or other abnormal shop situations.

Learning Activities

1. Read or review Vocational Trade and Industrial Education--Welding, pp. 5-A - 17-A.

2. Attend a lecture-demonstration on what contributes to unsafe conditions in the shop. Discuss:

   a. How personal working habits affect general shop safety.
   b. How alertness affects general shop safety.
   c. Local, state, and federal regulations that must be followed.
   d. Classroom rules that must be followed.

3. Discuss the intent and coverage of OSHA. Then,

   a. Read the "OSHA Safety and Health Standards Digest," if available, or read wall charts from the booklet on:
      (1) "Cylinders, Compressed Gas, Used in Welding"
      (2) "Welding"
   b. Locate items or areas of your classroom that are specifically referenced in OSHA Guidelines.

4. Tour the classroom with the instructor. Discuss:

   a. Traffic lanes and clearance zones.
   b. Maintenance of storage areas.
   c. Equipment operation.
   d. Potentially hazardous areas and equipment.
   e. Why equipment may be used only under the supervision of the instructor.

5. Make a list of the work stations in the shop:

   a. List the kinds of equipment in each different kind of work station.
   b. List the safety features for each of the kinds of equipment; i.e., location of stop switches, exhaust fans, etc.
   c. Color code your list with the appropriate federal safety color coding.
   d. Discuss special safety precautions necessary for each piece of equipment.

6. Attend a lecture-demonstration on the causes of fires and on extinguishing fires:

   a. List the kind of equipment/materials that would be necessary to extinguish fires caused by or occurring with specific components. (Review pp. 7-A and 8-A, Vocational Trade and Industrial Education--Welding.)
   b. Locate the fire extinguishers in your shop.
   c. Demonstrate the operation of the types of fire extinguishers in the shop.

7. With the class, make an emergency plan for your shop.

   a. Compare the class plan with the existing school plan.
   b. If you are unclear of any of the steps, discuss them with the instructor.

8. Rehearse the emergency plan for your shop. Role-play several situations: fire, burns and other injuries, heart failure due to electrical shock, etc.

9. Answer the questions on the Safety Test, pp. 17-A, 18-A, and 19-A, Vocational Trade and Industrial Education--Welding.

   a. Your instructor will check your work.
   b. Discuss anything you are unsure of with the instructor and class.

UNIT D

BASIC MATHEMATICS

Terminal Objectives

Upon completion of the modules in this unit, you will:

- Compute whole numbers
- Compute common fractions
- Compute decimal fractions
- Calculate/express percentages, averages, and estimates

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Student Competency Sheet

Unit D: BASIC MATHEMATICS

Task 1: COMPUTE WHOLE NUMBERS

Performance Checklist

1. Convert written numbers to Arabic numerals.
2. Add whole numbers to find the sum:
    a. Write one number under another so the unit digits are in the units column, tens in the tens column, etc.
    b. Add all the numbers in the units column.
    c. Write the unit digit at the bottom of the column. If a column sum is more than 9, put the second digit at the top of the next column to the left.
    d. Add the numbers in the tens column. Write the last digit in this sum in the tens column. If the sum is greater than 9, put the second digit at the top of the hundreds column.
    e. Continue to add each column of numbers in the same manner.
    f. Check for accuracy by adding from bottom to top of columns.
3. Subtract whole numbers to find the difference (remainder).
    a. Write the larger of the two numbers (the minuend).
    b. Write the number to be subtracted (subtrahend) directly below the minuend. All digits must be in the respective columns (unit below unit, ten below ten, etc.).
    c. Start with the units column; subtract the number in the subtrahend (lower number) from the minuend (number at the top).
    d. Continue in the same manner with the tens, hundreds, etc., to compute the difference.
    e. Check for accuracy by adding the subtrahend and the difference.
4. Multiply whole numbers to find the product.
    a. Write the larger of the two numbers as the multiplicand. Below it, write the multiplier (the smaller of the two numbers) so that the units, tens, hundreds, etc., values are in the same columns.
    b. Multiply the numbers in the units column. Write the result in the units column and carry over the tens to the tens column.
    c. Multiply the number in the tens column of the multiplicand (top number) by the number in the units column of the multiplier (lower number). Add the tens remainder (carried over from the units column) to this product.
    d. Write the first digit on the right (i.e., the "9" if the number is "19" in the tens column.
    e. Carry over any numerals representing hundreds; add to the next product. (If no other numbers are to be multiplied, write each digit result in the proper column.)
    f. Continue to multiply every number in the multiplicand; write each digit in the result in the proper column, carrying over as needed.

   g. Add the results in each column.
   h. Check for accuracy: write the multiplicand as the multiplier; the multiplier as the multiplicand (i.e., reverse the top and bottom numbers of the original problem). Multiply again (rework) and check the product with the original product.

5. Divide whole numbers to find the quotient.
   a. Write the number to be divided as the dividend, inside the division frame. Write the divisor (number to be divided into the dividend) to the left of the dividend, but outside the frame.
   b. Determine (estimate) how many times the numerals in the first few digits (left to right) of the dividend may be divided by the divisor. (This is the "trial quotient.") Write it over the units column of the dividend (in the line formed by the top of the frame).
   c. Test your estimate: multiply the divisor by the trial quotient, units first, the tens, etc. Place the product under the dividend.
   d. Subtract the product from the dividend; write the difference in the columns below the units, tens, etc., of the numbers just calculated.
   e. Copy (bring down) the numeral in the next place (to the right of the numbers just used) in the dividend. If the remainder cannot be divided by the divisor, bring down the next numeral in the dividend.
   f. Repeat the division process until all numerals in the dividend are used. When the divisor does not divide evenly into the dividend, the number left over after the last subtraction is the remainder.

Test

Items Needed:
1. Paper
2. Pencil
3. Practice sheets
4. Ruler or steel tape

Task: Add, subtract, multiply, and divide whole numbers.

Standard: Computation of sums/differences/products/quotients must be at least 95% accurate in each of the operations.

Learning Activities

1. Read Basic Mathematics Simplified, pp. 1-6.

   a. Watch a demonstration by your instructor.
   b. Complete the Assignment Unit of the unit you read.

        (3) Subtract the whole numbers and reduce the resulting mixed number to its lowest terms.
    d. Subtract mixed numbers from mixed numbers:
        (1) Use the least common denominator to express the fractional part of each mixed number.
        (2) Borrow one unit, when necessary, to make up a fraction that is larger than the one to be subtracted.
        (3) Subtract the fractions first, the whole numbers next. Express the results (difference) in lowest terms.
5. Multiply common fractions.
    a. Multiply two or more fractions:
        (1) Multiply the numerators.
        (2) Multiply the denominators.
        (3) Write the product of the numerators over the product of the denominators.
        (4) Express the product fraction in lowest terms.
    b. Multiply a common fraction by a mixed number:
        (1) Express the mixed number as an improper fraction where the numerator is larger than the denominator.
        (2) Multiply the numerator of the improper fraction by the numerator of the common fraction.
        (3) Multiply the denominators.
    c. Multiply fractions, whole numbers, and mixed numbers:
        (1) Express all mixed numbers as improper fractions.
        (2) Place all whole numbers over a denominator of 1.
        (3) Multiply all numerators.
        (4) Multiply all denominators.
        (5) Express product in lowest terms.
6. Divide common fractions.
    a. Divide fractions:
        (1) Invert the divisor (turn the fraction upside down so the denominator becomes the numerator, the numerator becomes the denominator.
        (2) Change the division sign to a multiplication sign; multiply.
    b. Divide fractions and whole numbers:
        (1) Express the whole number as a fraction (write the number over a denominator, which is "1".)
        (2) Invert the divisor.
        (3) Multiply the fractions.
    c. Divide mixed numbers:
        (1) Express mixed numbers as improper fractions.
        (2) Invert the divisor.
        (3) Multiply the fractions.

Test

Items Needed: 1. Pencil
2. Paper
3. Practice sheets
4. Ruler or steel tape

   c. If your instructor provides you with additional problems, complete them.
   d. Have your instructor check your work.

2. Read Basic Mathematics Simplified, pp. 7-10.

   a. Watch a demonstration by your instructor.
   b. Complete the Assignment Unit of the unit you read.
   c. Complete any practice sheets provided by your instructor.
   d. Have your instructor check your work.

3. Read Basic Mathematics Simplified, pp. 11-15.

   a. Watch a demonstration by your instructor.
   b. Complete the Assignment Unit of the unit you read.
   c. Complete any practice sheets provided by your instructor.
   d. Have your instructor check your work.

4. Read Basic Mathematics Simplified, pp. 16-19.

   a. Watch a demonstration by your instructor.
   b. Complete the Assignment Unit of the unit you read.
   c. Complete any practice sheets provided by your instructor.
   d. Have your instructor check your work.

5. Make up your own problems in each of the four operations (addition, subtraction, multiplication, division).

   a. Compute the answers without using a calculator.
   b. Have a partner compute the answers.
   c. Do the problems written by your partner.

   (Suggested activity for developing problems: measure several items in the shop area to the nearest whole number; for example, the classroom, windows, pipe or wire, a stack of books.)

6. Take the "Achievement Review for Whole Numbers," pp. 20-22, Basic Mathematics Simplified, or another test supplied by your instructor.

   a. Your instructor will evaluate your work.
   b. Discuss problem areas with your instructor.
   c. Set up a schedule for completing additional assignments in any of the operations where you and your instructor feel you need a stronger background.

Student Competency Sheet

Unit D: BASIC MATHEMATICS

Task 2: COMPUTE COMMON FRACTIONS

Performance Checklist

1. Demonstrate understanding of the concept, interpretation, and use of common fractions.
2. Reduce fractions to lowest common denominator (lowest terms).
    a. Proper fractions: divide the numerator (above the line) and the denominator (below the line) by the same number. (Reduce to lowest terms.)
    b. Improper fractions: Divide the numerator by the denominator. (Reduce to lowest terms.)
3. Add common fractions.
    a. Change all fractions to be added to fractions having a least common denominator.
    b. Add the numerators.
    c. Write the sum over the common denominator.
    d. Reduce the sum to its lowest terms.
    e. If adding whole numbers, mixed numbers, and common fractions:
        (1) Add the whole numbers.
        (2) Add the fractions.
        (3) Add the two sums.
        (4) Reduce the result to lowest terms.
4. Subtract common fractions.
    a. Subtract proper fractions:
        (1) Use the lowest common denominator to express all fractions.
        (2) Subtract the numerators.
        (3) Write the difference over the lowest common denominator.
        (4) Reduce the resulting fraction to lowest terms.
    b. Subtract a fraction from a whole number:
        (1) Take one unit from the whole number; change into a fraction which has the same denominator as the fraction which is to be subtracted.
        (2) Subtract the numerators of the original fraction from the unit that was changed to a fractional value.
        (3) Express the resulting fraction in lowest terms.
        (4) Place the whole number next to the left of the fraction.
    c. Subtract a mixed number from a whole number:
        (1) Borrow a unit from the whole number; express it as a fraction which has the same denominator as the mixed number.
        (2) Subtract the fraction part of the mixed number from the fraction part of the whole number.

Task: Add, subtract, multiply, and divide common fractions.

Standard:
1. Results must be expressed as least common denominator.
2. Computation of sums/differences/products/quotients must be at least 95% accurate in each of the operations.

Learning Activities

1. Read Basic Mathematics Simplified, pp. 23-28.

2. Attend a lecture-discussion on how common fractions are used in welding and other occupations.

3. Measure objects in the classroom. Write the measurements, using fractions to express parts of an inch, foot, etc.

4. Practice reducing fractions to their lowest terms (the least common denominator), using the measurements you took in Learning Activity #3.

5. Read Basic Mathematics Simplified, pp. 29-32.

   a. Watch a demonstration by your instructor.
   b. Complete the Assignment Unit of the unit you read.
   c. Have your instructor check your work.

6. Read Basic Mathematics Simplified, pp. 33-38.

   a. Watch a demonstration by your instructor.
   b. Complete the Assignment Unit of the unit you read.
   c. Have your instructor check your work.

7. Read Basic Mathematics Simplified, pp. 39-43.

   a. Watch a demonstration by your instructor.
   b. Complete the Assignment Unit of the unit you read.
   c. Have your instructor check your work.

8. Read Basic Mathematics Simplified, pp. 44-48.

   a. Watch a demonstration by your instructor.
   b. Complete the Assignment Unit of the unit you read.
   c. Have your instructor check your work.

9. Make up your own problems in each of the four operations (addition, subtraction, multiplication, and division of fractions).

   a. Compute the answers.
   b. Have a partner compute the answers.
   c. Do the problems written by your partner.

(When writing problems, use the smallest fractional unit commonly expressed for whatever kind of measurement you are using, such as 1/64".)

10. Take the "Achievement Review for Common Fractions," pp. 49-51, Basic Mathematics Simplified, or another test supplied by your instructor.

    a. Your instructor will evaluate your work.
    b. Discuss problem areas with your instructor.
    c. Set up a schedule for completing additional assignments in any of the operations where you and your instructor feel you need a stronger background.

Student Competency Sheet

Unit D: BASIC MATHEMATICS

Task 3: COMPUTE DECIMAL FRACTIONS

Performance Checklist

1. Express whole numbers and common fractions as decimal numbers and fractions.
2. Read decimals.
3. Round off decimals.
    a. Determine the degree of accuracy to be expressed. Use the digit in that decimal place unless the digit to its right is 5 or more.
    b. If digit to the right of the digit in the decimal place is 5 or more, increase the digit in the decimal place by one (1).
    c. Drop all other digits that follow.
4. Add decimals.
    a. Write the numbers one under the other so that all decimal points are in a vertical column.
    b. Add each column.
    c. Place the decimal point in the answer directly below the decimal points of the numbers added.
5. Subtract decimals.
    a. Write the numbers so that decimal points are under each other.
    b. Subtract each column of numbers.
    c. Place the decimal point in the answer directly below the decimal points of the numbers subtracted.
6. Multiply decimals.
    a. Multiply the same way as with whole numbers.
    b. Total the number of decimal places to the right of the decimal point in both of the numbers being multiplied.
    c. Locate the decimal point in the answer.
7. Convert percent values to or from decimals.
    a. Change percent to decimal:
        (1) Remove the % sign.
        (2) Place a decimal point two digits to the left of the number.
    b. Change decimal to percent:
        (1) Move the decimal point two places to the right.
        (2) Place "%" after this number.
8. Divide decimals.
    a. Place dividend (number to be divided) inside the division frame.
    b. Place the divisor outside the frame (to the left).
    c. Move the decimal point in the divisor to the right so that it becomes a whole number.

d. Move the decimal point the same number of places to the right of the dividend. (Add zeroes if the dividend has fewer digits than the divisor.)
e. Mark the position of the decimal point in the quotient.
f. Divide as whole numbers. (Place each figure in the quotient directly above the digit involved in the dividend.)
g. Add zeroes after the decimal point in the dividend if it cannot be divided exactly by the divisor.
h. Continue to divide until the quotient has as many places as are required.

Test

Items Needed:
1. Pencil
2. Paper
3. Practice sheets
4. Ruler or steel tape

Task: Add, subtract, multiply, and divide decimal fractions.

Standard:
1. Results must be expressed to the decimal unit specified.
2. Computation of sums/differences/products/quotients must be at least 95% accurate in each of the operations.

Learning Activities

1. Read Basic Mathematics Simplified, pp. 52-57.
2. Attend a lecture-discussion on how decimal fractions are used in welding and other occupations. Discuss:

   a. How to interpret the decimal system.
   b. How to write decimal fractions.
   c. How to read decimal fractions.

3. Attend a lecture-demonstration on how to convert fractions to decimals.

   a. Measure objects in the classroom.
   b. Write the measurements, using decimals to express parts measured.
   c. Practice converting fractions to decimals.

4. Complete the Assignment Unit on pp. 55-57. Have your instructor check your work.

5. Read Basic Mathematics Simplified, pp. 58-60 and 61-63.
    a. Watch a demonstration by your instructor.
    b. Complete the Assignment Units of these units.
    c. Have your instructor check your work.

6. Read Basic Mathematics Simplified, pp. 64-68.
    a. Watch a demonstration by your instructor.
    b. Complete the Assignment Unit for the unit you read.
    c. Have your instructor check your work.

7. Read Basic Mathematics Simplified, pp. 69-73.
    a. Watch a demonstration by your instructor.
    b. Complete the Assignment Unit for the unit you read.
    c. Have your instructor check your work.

8. Take the "Achievement Review of Decimal Fractions," pp. 74-76, Basic Mathematics Simplified.
    a. Your instructor will evaluate your work.
    b. Discuss problem areas with your instructor.
    c. Set up a schedule for completing additional assignments in any of the operations where you and your instructor feel you need a stronger background.

Student Competency Sheet

Unit D: BASIC MATHEMATICS

Task 4: CALCULATING/EXPRESSING PERCENTAGES, AVERAGES, AND ESTIMATES

Performance Checklist

1. Percentages
   - a. Demonstrate understanding of the concepts and uses of "percents."
   - b. Change whole numbers, common fractions, and decimals to percents.
   - c. Find the percent of a number:
     - (1) Convert the percent to either a fractional or decimal equivalent.
     - (2) Multiply the given number by the fractional or decimal equivalent.
     - (3) Point off the same number of decimal places in the product as there are in the multiplier and multiplicand.
     - (4) Label the answer with the appropriate unit of measure.
   - d. Find percentage from base and rate:
     - (1) Write the formula P=BxR (Percentage = Base x Rate).
     - (2) Substitute the given values for the B and R (change the given percent to its decimal equivalent).
     - (3) Multiply.
     - (4) Check for accuracy: substitute the answer for P and rework to see that quantities on both sides of the = sign are equal.
2. Averages
   - a. Demonstrate understanding of the concept and uses of "averages."
   - b. Calculate averages from given values:
     - (1) Check the units of measure in each quantity to be sure they are the same.
     - (2) Arrange the quantities in a column; add.
     - (3) Divide the sum by the number of quantities to get the average.
   - c. Determine values from averages:
     - (1) Multiply the average by the number of quantities.
     - (2) Add the given quantities.
     - (3) Subtract this sum from the product. The difference is the missing value.
3. Estimating
   - a. Demonstrate understanding of the concept and uses of "estimating."
   - b. Estimate to check mathematical accuracy:
     - (1) Work the problem as usual.

    (2) Reread the original problem; determine what numbers can be rounded off.
    (3) Use these numbers and perform the operations as required.
    (4) Count off decimal places in the answer very carefully.
    (5) Check the computed value by comparing the original answer with the estimated value.

c. Estimate to determine time, costs, materials, or other factors:
    (1) Collect information and select or compute averages.
    (2) Perform required mathematical operations; label answers.
    (3) Total all computations. Rework to check.
    (4) Round off quantities and amounts; perform mathematical operations.
    (5) Check the accurate estimate against the rounded-off estimate.

Test

Items Needed:
1. Pencil
2. Paper
3. Practice sheets

Task:
1. Change whole numbers, common fractions, and decimals to percentages.
2. Compute percentage from "base" and "rate."
3. Calculate averages from given values.
4. Calculate values from averages.
5. Estimate to check mathematical accuracy.
6. Estimate to determine time, costs, materials, and other factors of a proposed unit of work.

Standard:
1. Percentage and average answers must be 100% accurate.
2. Estimates may be ± 5% of accurate figures.

Learning Activities

1. Read Basic Mathematics Simplified, pp. 131-135.

2. Attend a lecture-discussion on how "percents" are used in welding, other industries, etc. Discuss:

    a. How to interpret a "percent" statement.
    b. How to express other numbers as percents.

3. Attend a lecture-demonstration on how to:

    a. Find the percent of a number.
    b. Change percents to decimals and fractions.
    c. Practice these procedures.

4. Complete the Assignment Unit on pp. 133-135.
    a. Have your instructor check your work.
    b. Discuss anything about which you are unsure.

5. Read Basic Mathematics Simplified, pp. 136-138.
    a. Watch a demonstration by your instructor.
    b. Complete the Assignment Unit for the unit you read.
    c. Have your instructor check your work.

6. Read Basic Mathematics Simplified, pp. 139-142.
    a. Watch a demonstration by your instructor.
    b. Complete the Assignment Unit for the unit you read.

7. Take the "Achievement Review of Percentage and Averages," pp. 143-144, Basic Mathematics Simplified.
    a. Your instructor will evaluate your work.
    b. Discuss problem areas with your instructor.
    c. Set up a schedule for completing additional assignments in any of the operations where you and your instructor feel you need a stronger background.

UNIT E

MEASURING

Terminal Objectives

Upon completion of the modules in this unit, you will:

- Use basic measuring tools
- Convert Standard English measurements to metric values

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Student Competency Sheet

Unit E: MEASURING

Task 1: USE BASIC MEASURING TOOLS

Performance Checklist

1. Interpret terms used in measuring.
2. Identify measuring tools.
3. Measure objects.
4. Draw lines and objects.

Test

Items Needed:
1. Steel rule
2. Steel square
3. Steel tape
4. Outside calipers
5. Inside calipers
6. Combination square
7. Protractor
8. Pencil
9. Paper
10. Objects (or pictures of objects) to be measured and drawn

Task: Use basic tools to measure and draw three objects.

Standard:
1. Objects will be measured to the nearest sixteenth of an inch.
2. Lines and objects will be drawn to specified dimensions.

Learning Activities

1. Attend a lecture-demonstration on the use of basic measuring terms and tools used by welders.

2. Read Vocational Trade and Industrial Education--Welding, pp. 83-B - 110-B.

   a. Complete the Assignment Sheets (pp. 97-B and 98-B; 99-B and 100-B; and 101-B and 102-B).
   b. Have your instructor check your work.

3. Practice using the six basic tools. Use objects or practice sheets provided by your instructor.

   a. Demonstrate the use of each tool.

   b. Discuss where and when to use each tool.
   c. Discuss the consequences of inaccurate measurement.

4. Make a list of definitions commonly used in expressing standard English measurements.

5. Your instructor will provide three (3) objects or pictures of objects:

   a. Measure the objects to the nearest 1/4", 1/8", and 1/16".
   b. Draw the objects to the specified dimensions.

6. Practice converting measured dimensions of an object to a scale drawing. (Your instructor will specify the scale to be used.)

7. Practice converting measured dimensions (using the five (5) basic tools for linear measurement to decimal equivalents).

8. Practice converting decimals to fractions.

9. Draw several circles.

   a. Randomly divide and mark the circles.
   b. Measure and mark the degrees of the angles.

10. Practice measuring angles of objects (or pictures) provided by your instructor.

11. If you are having any problems in reading or computing measurements, ask your instructor to provide additional Learning Activities. One suggested resource is Basic Mathematics Simplified, 4th ed., Section 4 (pp. 77-130).

Student Competency Sheet

Unit E: MEASURING

Task 2: CONVERT TO METRIC VALUES

Performance Checklist

1. Obtain objects, or pictures of objects, to be measured.
2. a. Take standard English measurements.
   b. Convert to metric equivalents.
3. a. Take metric measurements.
   b. Convert to standard English equivalents.
4. Draw objects, using metric values.
   a. Label measurements, according to metric values.
   b. Label measurements, according to standard English values.

Test

Items Needed:

1. Three objects, or pictures of objects, with linear dimensions
2. Three objects with weight (mass)
3. Three liquid containers, with standard English volume values
4. Three liquid containers, with metric volume values
5. Thermometers: Celsius and Fahrenheit
6. Metric and standard English:
   a. Steel rule
   b. Steel tape
   c. Steel square
   d. Combination square
7. Inside calipers
8. Outside calipers
9. Paper
10. Pencil

Task:

1. Convert metric measurements to standard English equivalents.
2. Convert standard English measurements to metric equivalents.
3. Draw and label objects, using metric values to express linear, mass, and volume measurements.

Standard:

1. All measurements will be accurately expressed in both standard English and metric values.
2. Reproductions will be drawn accurately to metric measurements and to standard English equivalents.

Learning Activities

1. Attend a lecture-demonstration on metric measurements and tools.

2. Read Welding Skills and Practices (5th ed.), Ch. 38.

    a. Complete Lesson No. 4, "Understanding the Metric System," in Student Activity Manual for Welding Skills and Practices.
    b. Have your instructor check your work.

3. Read Basic Mathematics Simplified (4th ed.), Sect. 8, "Metrication: Organization and Systems."

    a. Complete the "Assignment Units" in this chapter.
    b. Complete the "Achievement Review on SI Metrics and Conventional Metrics," Unit 38 (pp. 208-211).
    c. Have your instructor check your work.

4. Discuss the advantages or disadvantages of the metric system and the standard English measurements. Include:

    a. How and why each was developed.
    b. Uses in industry (American and foreign).
    c. Availability of tools and equipment.

5. Make a list of metric symbols and definitions.

6. In your notebook, make your own tables showing:

    a. Values of Metric Units of Linear Measurement
    b. Values of Metric Units of Square Measurement
    c. Values of Metric Units of Volume
    d. Values of Standard English Units Expressed in Metric Equivalents

7. Examine thermometers by which temperature is expressed in (a) Celsius and (b) Fahrenheit.

    a. Discuss the advantages/disadvantages of each.
    b. Discuss industries (types of work) where these are being used.

8. From your instructor, obtain objects which have linear, mass, and volume measurements.

    a. Take measurements with standard English tools. Write the measurements.
    b. Take measurements with metric tools. Write the measurements below the standard English notations.
    c. Refer to a conversion chart to check your work.

9. Practice drawing, or reproducing drawings, of objects.

    a. First, use standard English tools.
    b. Draw the objects a second time, using metric tools.

10. From your instructor, obtain three (3) objects which have linear measurements and three which have mass.

    a. Measure and reproduce the objects, using standard English measurements.
    b. Measure and reproduce the objects, using metric measurements.
    c. Have your instructor evaluate your work.

UNIT F

READING BLUEPRINTS

Terminal Objectives

Upon completion of the modules in this unit, you will:

- Identify basic information found on blueprints
- Identify metal shapes, views, and sections
- Interpret welding abbreviations and symbols

Student Competency Sheet

Unit F: READING BLUEPRINTS

Task 1: IDENTIFY BASIC PRINT INFORMATION

Performance Checklist

1. Interpret meanings of lines.
2. Interpret orthographic projection.
3. Interpret notes and specifications.
4. Interpret size specifications.
5. Interpret location specifications.

Test

Items Needed:	1. Blueprints 2. Drawing paper 3. Pencil
Task:	Identify the basic information on a blueprint.
Standard:	All lines, orthographic projections, notes, and specifications will be located and named correctly.

Learning Activities

1. Start a notebook of Welding Symbols, Terms, and Definitions.
    a. Keep this notebook current as you read and attend lectures.
    b. Write any terms of which you are unsure.
        (1) Research the answers.
        (2) Discuss the terms with the instructor and class.
        (3) Write them in your notebook.

2. Read and discuss the following:
    a. *Blueprint Reading for Welders* (Delmar Publishers, 1973), pp. 7-35.
    b. *Vocational Trade and Industrial Education--Welding* (Oklahoma State Department of Vocational and Technical Education), pp. 1C - 11-C.
    c. Complete the "activities" and "reviews" in these readings.
    d. Discuss your answers with the class.
    e. If you had any problems with your calculations, ask your instructor to give you additional practice problems.

3. Attend a lecture-demonstration on blueprint reading. Discuss:

   a. Why it is important to follow directions accurately.
   b. Why mathematics skills are important in blueprint reading.

4. Attend a lecture-demonstration on how to print.

   a. Practice printing the letters of the alphabet.
   b. Practice printing words.
   c. Practice printing the numerals and letters that appear on illustrations in your text.
   c. Have your instructor check your work.

5. Ask your instructor for several blueprints. Work with a partner: name and define:

   a. Lines
   b. Orthographic projections
   c. Notes and specifications
   d. Size specifications
   e. Location specifications

6. Your instructor will provide one or more blueprints:

   a. Identify and define the information listed in Activity 4.
   b. Have your instructor evaluate your performance.

Student Competency Sheet

Unit F: READING BLUEPRINTS

Task 2: IDENTIFY METAL SHAPES, VIEWS, AND SECTIONS

Performance Checklist

1. Interpret size specifications.
2. Identify appropriate metal stock by:
   a. Gage number
   b. Nearest fraction of an inch
   c. Decimal equivalent
   d. Weight
3. Select metal workpieces and demonstrate blueprint rendering of:
   a. Conventional breaks
   b. Revolved sections
   c. Auxiliary and developed views
   d. Full and half sections

Test

Items Needed:
1. Blueprints
2. Metal workpieces
3. Graph paper
4. Drawing paper
5. Pencil

Task: Identify shapes, gages, views, and sections specified on each of three blueprints.

Standard:
1. Identify correct metal stock, by type and gage.
2. Identify gage by nearest fraction of an inch.
3. Identify gage by decimal equivalent.
4. Accurately demonstrate, on metal workpieces, the interpretations (of breaks, sections, full and half sections, and auxiliary and developed views) specified on the blueprint.

Learning Activities

1. Read Blueprint Reading for Welders, pp. 36-79.

2. Attend a lecture-demonstration on metal shapes, views, and sections. With your class, discuss how you use this information.

3. Write new terms in your notebook.

4. Complete the "reviews" in Blueprint Reading for Welders, pp. 44-45; 47; 49; 51; 62-63; 65; 67; 69; 73; 75; and 79.

5. Examine samples of metals. Identify and discuss them by:

   a. Structural shape
   b. Gage (and fraction and decimal dimensions)
   c. Name
   d. Composition and properties
   e. Uses

6. Using blueprints and sample workpieces:

   a. Demonstrate, on the workpiece, the actual linear dimensions of the blueprint.
   b. Demonstrate, on the workpiece, the breaks, views, etc., represented in the blueprint.

7. Read two (2) blueprints:

   a. Convert the blueprint dimensions to scale size.
   b. Draw the specified structural shape.

8. Draw a blueprint, to scale, of an item provided by your instructor. Include all lines, sections, and other information you have studied so far in this unit.

9. Obtain three (3) blueprint drawings from your instructor. Identify:

   a. Metal stock by type and gage.
   b. Gage by nearest fraction of an inch.
   c. Gage by decimal equivalent.
   d. Obtain metal workpieces which fit the blueprints. Point out, on the workpieces, the matching information that interprets breaks, sections, full and half sections, and auxiliary and developed views.
   e. Have your instructor evaluate your work.

Student Competency Sheet

Unit F: READING BLUEPRINTS

Task 3: INTERPRET WELDING ABBREVIATIONS AND SYMBOLS

Performance Checklist

1. Identify letter abbreviations and designations on the blueprint.
2. Identify the welding process indicated by the letter designation.
3. Identify weld symbols.
4. Interpret weld symbols.
5. Identify welds that demonstrate the symbols.

NOTE: A course in technical drawing and/or blueprint reading is highly recommended.

Test

Items Needed:
1. Blueprints
2. Completed workpieces
3. Graph paper
4. Drawing paper, or practice sheets showing sections and other weld information
5. Pencil

Task:
1. Explain the significance of all abbreviations in five (5) blueprints.
2. Name the welding process(es) indicated by the letter designations on five (5) blueprints.
3. Identify, by correct name, the welds indicated on five (5) blueprints.

Standard: Welding symbols and abbreviations will be identified and correctly interpreted.

Learning Activities

1. Attend a lecture-demonstration on the interpretation and use of welding symbols and abbreviations.

2. Read Blueprint Reading for Welders, pp. 80-100 and 102-142.

   a. Complete the "reviews": pp. 82; 90; 93; 95-97B; 101; 106-107; 108-109; 114-115; 116; 119; 122-124; 126-127; 131; 135-136; 138; 143-144.
   b. Discuss these with your class.

3. For information only, read and discuss pp. 145-173, Blueprint Reading for Welders.

4. Make a list of common abbreviations. (See p. 80, Blueprint Reading for Welders.)
    a. Without assistance, write the meanings of the abbreviations.
    b. Check your work.

5. Practice drawing common symbols (p. 81, Blueprint Reading for Welders) and basic weld symbols (p. 85).

6. Attend a lecture-demonstration on the uses and purposes of the welds listed below:
    a. Fillet welds
    b. Groove welds
    c. Back or backing and melt-thru welds
    d. Plug and slot welds
    e. Surfacing welds, flash or upset welds
    f. Flange welds
    g. Spot welds
    h. Projection welds
    i. Seam welds

7. Practice drawing the symbols for the welds listed in Activity 6.

8. Attend a lecture-demonstration on the welding processes listed on page 99, Blueprint Reading for Welders.
    a. Discuss those welds most commonly used by welders who work in your area.
    b. Discuss the uses of the different welding processes; i.e., why is a particular process specified instead of another?
    c. Briefly discuss the major differences between the various welding processes listed.

9. With a partner, look at several blueprints. Identify the welding process specified and interpret the weld symbols.

10. Obtain five blueprints from your instructor. Locate and tell the meaning of:
    a. Abbreviations and common symbols
    b. Letter designations for weld processes
    c. Weld symbols
    d. Have your instructor evaluate your work.

UNIT I

OPERATING SHIELDED METALLIC ARC WELDING EQUIPMENT

Terminal Objectives

Upon completion of the modules in this unit, you will:

- Set up the SMAW machine to weld to the requirements of specified welding jobs
- Remove or replace SMAW equipment accessories
- Weld carbon steel, using SMAW equipment
- Weld heat and corrosion resistant (stainless) steel, using SMAW equipment
- Weld cast iron, using SMAW equipment
- Hard surface steel with arc welding equipment
- Cut carbon steel, using the shielded metallic arc cutting process
- Cut carbon steel, with the air carbon arc process
- Cut cast iron with the air carbon arc process

Student Competency Sheet

Unit I: OPERATING SHIELDED METALLIC ARC WELDING EQUIPMENT

Module A: Equipment Set up

Task 1: SET UP MACHINE FOR CURRENT REQUIREMENTS

Performance Checklist

1. Read blueprint specifications to determine thickness of metal and type of joint.
2. Determine welding position to be used.
3. Check machine capacity.
4. Determine size of electrode to be used.

Test

Items Needed:

1. Blueprint
2. Metal with prepared joint
3. Electrode
4. Manufacturer's amperage range chart
5. Electro-welding guide
6. OSHA safety manual

Task:

1. Use amperage range chart to determine proper amount of amperage.
2. Set up machine to meet blueprint specifications.

Standard: Machine must be set within ± five (5) amps of correct setting.

Learning Activities

1. Read one of the following:
    a. *Welding Principles and Practices* (Sacks), pp. 165-194.
    b. *The Procedure Handbook of Arc Welding* (Lincoln Electric Company), pp. 1.3-1 to 1.3-4; 4.2-1 to 4.2-7; and 4.3-1 to 4.3-12.

2. Read one of the following:
    a. *Modern Welding* (Althouse/Turnquist/Bowditch), pp. 6-1 to 6-30 and 7-1 to 7-16.
    b. *Welding Technology* (Kennedy), pp. 299-321.
    c. *Welding Skills and Practices* (Giachino/Weeks), pp. 55-81.

3. In your notebook of Welding Symbols, Terms, and Definitions, title the first section "Arc Welding."

    a. In this section, write the terms and definitions found in the readings for this task. Add to your list as you complete other Student Competency Sheets and from lecture notes.
    b. Define the terms listed on Information Sheet I-A-1 ("Terms").
        (1) Write the terms and definitions in your notebook.
        (2) Point out examples of the terms to your class instructor.

4. In your Safety Notebook, write Personal and General Shop Safety Practices found in your readings, as well as those given by the instructor during lectures and demonstrations.

    a. List five personal safety practices for setting up machines.
    b. List five general shop safety practices for setting up machines.

5. Study Information Sheet I-A-1a ("Welding Circuit") and Information Sheet I-A-1b ("Standardized AWS Classification").

6. After lecture-demonstration by your instructor on each of the following topics:

    a. Explain how to read a blueprint to obtain required information.
    b. Make a list of and identify (to your instructor or class): parts, controls, and capacity of SMAW equipment.
    c. Explain the principles of arc welding.
    d. List and identify (for your instructor and class) four (4) of the most commonly used electrodes of various sizes and materials. Explain when and why they are used and how to use them. (Refer to electro-welding guide.)
    e. Explain how to read, interpret, and apply the information on an amperage range chart.

7. Attend a lecture on safe procedures for cleaning and setting up shielded metallic arc welding (SMAW) equipment. (Take notes.)

8. Observe a demonstration on setting up SMAW equipment to blueprint specifications.

9. Read Information Sheets I-A-1c, I-A-1d, and I-A-1e.

    a. With your class, discuss the consequences of not following each of the 12 safety procedures. [Information Sheet I-A-1c ("Safety for the Arc Welder") and Information Sheet I-A-1d ("Safety Precautions")]
    b. Locate the diagrammed items on your own shop equipment. (Information Sheet I-A-1e)

10. Set up SMAW equipment as demonstrated by your instructor (Learning Activity 8). Check each step of your set-up against blueprint requirements. Follow all safety procedures.

11. Obtain a blueprint from your instructor:
    a. Locate information you need to set up SMAW equipment for the operation.
    b. Define the weld symbols on the blueprint.

12. Using the blueprint from Learning Activity 11, write or explain to your instructor and/or class:
    a. Size of electrode to be used; material of electrode.
    b. Thickness of metal specified.
    c. Type of joint specified.
    d. Welding position to be used.
    e. Amount of amperage to be used.
    f. Safety equipment and procedures to be used.

13. Set up SMAW equipment to blueprint (Learning Activity 11 blueprint) specifications. Your instructor must approve the set-up and the safety procedures used.

14. Attend a lecture-demonstration on how to start and maintain an arc (flat position). Make note of safety procedures.

15. Under your instructor's supervision:
    a. Start and maintain an arc. (Your instructor must be present.)
    b. Apply the arc to a workpiece. (Your instructor must be present.)
    c. Turn off and disconnect the equipment. (Your instructor must be present.)

16. Dismantle SMAW equipment. Store equipment and materials in their correct storage areas. Instructor's shop policy must be followed.

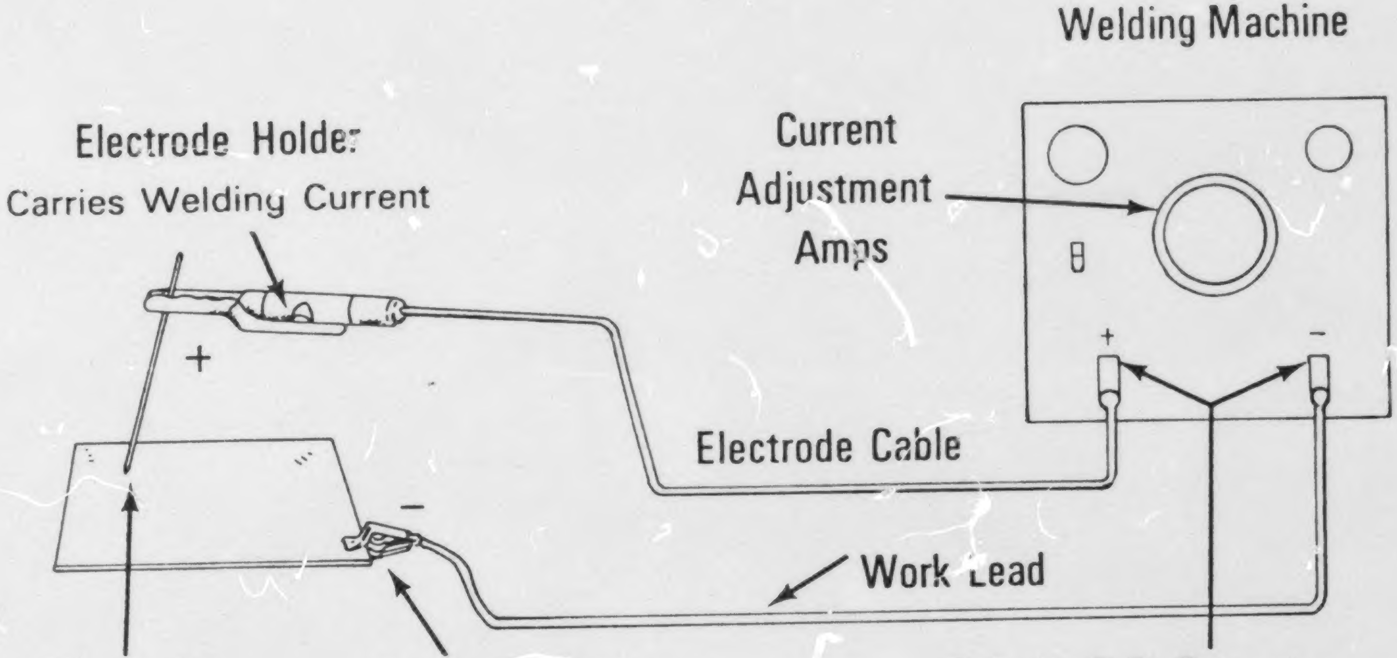
17. Clean up the work area. Instructor's shop policy must be followed.

Information Sheet I-A-1

Terms

1. AC welder
2. AWS
3. Base metal
4. Current adjustment
5. DC welder
6. Electrode
7. Electrode cable
8. Electrode holder
9. Flux
10. Ground cable
11. Ground clamp
12. Insulated
13. Load condition
14. Polarity
15. Reverse polarity
16. Shield metal arc welding
17. Straight polarity
18. Weld metal
19. Welding position
    a. Flat
    b. Horizontal
    c. Vertical
    e. Overhead
20. Work lead

Welding Circuit


Welding Machine
Current Adjustment Amps
Electrode Holder
Carries Welding Current
+
+
−
−
Electrode Cable
Work Lead

Electrode
Diameters:
1/16 - 5/16 x 14'
Most Common
Length

Grounded Work
Completes
Welding Circuit

Polarity-D.C. Current

Reverse:

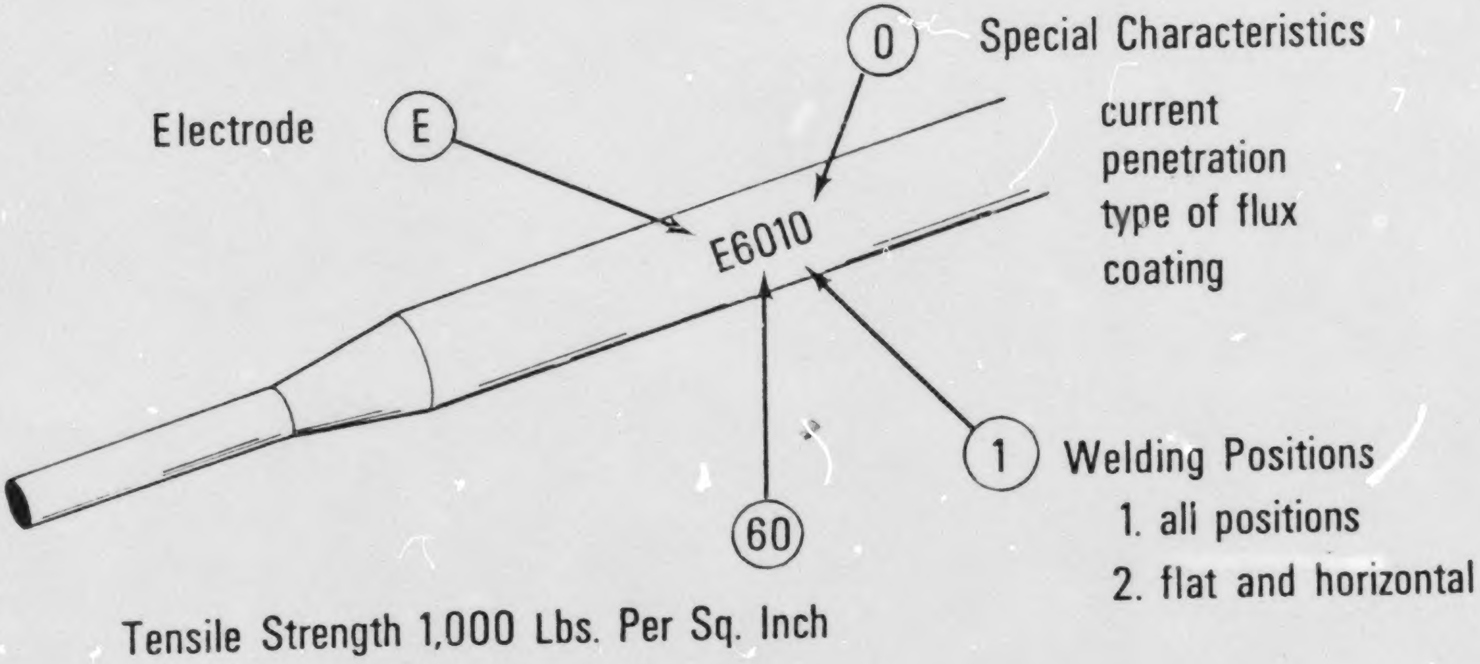
1. Electrode (+)
2. Current flows from work to electrode
3. 2/3 heat at (+) electrode
   1/3 heat at (-) work

Straight:

1. Electrode (-)
2. Current flows from electrode to work
3. 2/3 heat at (-) work
   1/3 heat at (+) electrode

Reprinted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

Standardized AWS Classification


0
Special Characteristics
current
penetration
type of flux
coating
Electrode
E
E6010
1
Welding Positions
1. all positions
2. flat and horizontal
60
Tensile Strength 1,000 Lbs. Per Sq. Inch

E6010 Mild Steel Electrode

Reprinted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

Information Sheet I-A-1c

Safety for the Arc Welder

1. Operate only with instructor's permission and after you have received instruction.
2. Remove jewelry, eliminate loose clothing, and confine long hair.
3. Make sure all guards are in place and operating correctly.
4. Always use proper eye protection.
5. A welding helmet must be worn when welding.
6. Proper ventilation must be available.
7. Goggles must be worn when chipping slag.
8. Others in the area must be warned prior to striking an arc.
9. Gloves and proper clothing must be worn when welding.
10. Closed containers should not be welded without the instructor's permission.
11. Cables, clamps, and electrode holder should be checked and working properly.
12. Screens to protect others must be in place before welding is started.

Reprinted from: Pennsylvania Industrial Arts Safety Guide, Pennsylvania Department of Education, Industrial Arts Association of Pennsylvania, 1978.

Information Sheet I-A-1d

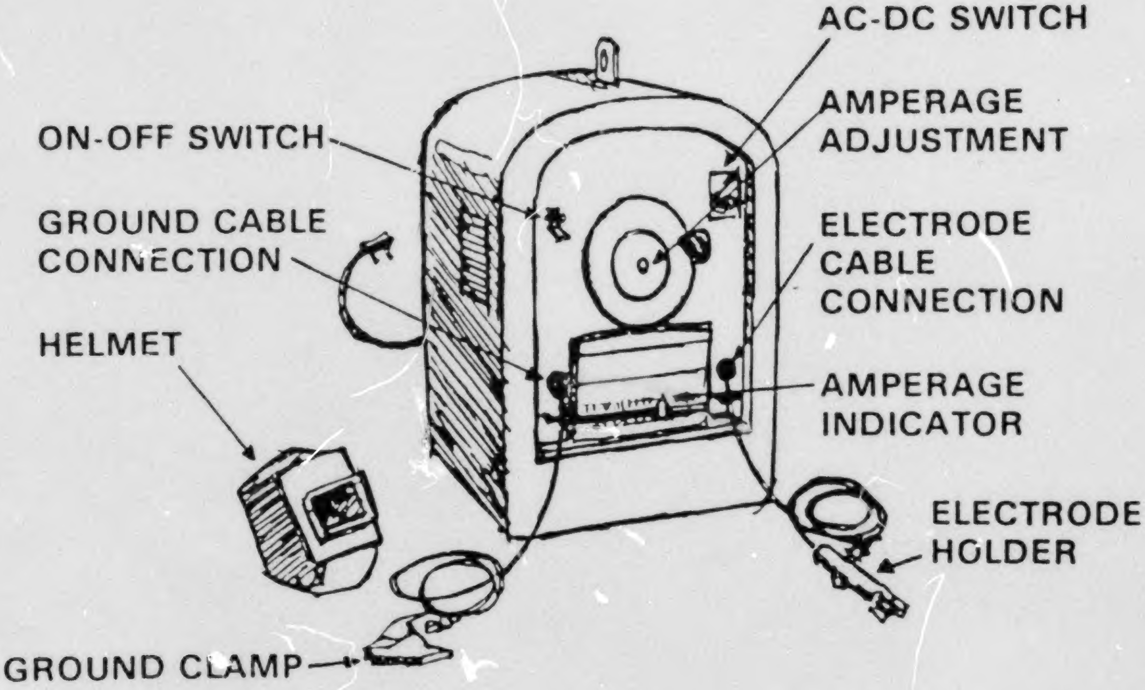
Safety Precautions

1. Keep equipment in good, clean, dry condition.
2. Make sure all electrical connections are tight, clean, and dry.
3. Use correct size welding cables. Do not overload.
4. Be sure cables, holders, and connections are properly insulated.
5. Cut off power to welder before cleaning machine or making internal adjustments.
6. Never change polarity or current setting while machine is under load.
7. Observe normal operating care for electrical hazards.
8. Keep work area neat, clean, and dry.
9. Remove flammable material from welding area or shield them.
10. Do not weld near volatile, flammable liquids, or gases.
11. Dispose of hot electrode stubs in metal containers.
12. Never strike an arc on a compressed gas cylinder.
13. Use a non-reflecting welding curtain to protect others in area.
14. Do not pick up hot metals.
15. Do not leave electrode holder on welding table or in contact with grounded metal surface.
16. Keep tools and metal in their proper place.

Courtesy of: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

Information Sheet I-A-1e

Arc Welder


AC-DC SWITCH
AMPERAGE ADJUSTMENT
ON-OFF SWITCH
GROUND CABLE CONNECTION
ELECTRODE CABLE CONNECTION
HELMET
AMPERAGE INDICATOR
ELECTRODE HOLDER
GROUND CLAMP

Reprinted from: Pennsylvania Industrial Arts Safety Guide, Pennsylvania Department of Education, Industrial Arts Association of Pennsylvania, 1978.

Student Competency Sheet

Unit I: OPERATING SHIELDED METALLIC ARC WELDING EQUIPMENT

Module A: Equipment Set up

Task 2: REMOVE OR REPLACE SMAW EQUIPMENT ACCESSORIES

Performance Checklist

1. Check and make sure that electrical power is off.
2. Obtain necessary tools.
3. Remove electrode and ground cables from machine.
4. Disassemble ground clamp from cable.
5. Disassemble electrode holder from cable.
6. Inspect cables, holder, and clamp.
7. Replace or repair defective parts.
8. Reassemble ground clamp to cable.
9. Reassemble electrode holder to cable.
10. Reconnect cables to machine.

Test

Items Needed:
1. Work order with sketch
2. Safety equipment
3. SMAW machine
4. Tools and accessories

Task:
1. Remove, disassemble and inspect cables, ground clamp, and electrode holder on a SMAW unit.
2. Reassemble and reconnect cables, ground clamp, and electrodes on a SMAW unit.

Standard:
1. The cables, ground clamp, and electrode holder will be removed, disassembled, inspected, reassembled, and reconnected in accordance with the work order.
2. The removal, disassembly, inspection, reassembly, and reconnection will be performed in the sequence listed in the work order and all safety procedures will be followed.

Learning Activities

1. Read one (1) of the following:
   a. *Welding Principles and Practices* (Sacks), pp. 183-186.
   b. *The Procedure Handbook of Arc Welding* (Lincoln Electric Company), pp. 4.3-1 to 4.3-10.

2. Read one of the following:

   a. Modern Welding (Althouse/Turnquist/Bowditch), pp. 6-10 to 6-14 and 8-11 to 8-12.
   b. Welding Skills and Practices (Giachino/Weeks), pp. 55-69.
   c. Welding Technology (Kennedy), pp. 307-313.

3. In your notebook, list terms and definitions found in the readings.

4. List safety practices in the Safety notebook. List must include at least:

   a. Five (5) personal safety practices.
   b. Five (5) general shop safety practices.

5. Attend a lecture on shop safety and safe work habits. Question your instructor on any points you do not understand.

6. Discuss safety with your class in terms of topics such as:

   a. OSHA
   b. State regulations
   c. Local regulations
   d. Metal arc welding safety
   e. Equipment care
   f. Equipment usage
   g. Tools
   h. Material handling
   i. Clothing
   j. Shop housekeeping
   k. Accident reporting

   Work in groups of two or three to investigate these topics. Then, present your report to the class.

7. Attend a lecture on basic weld joint design. Discuss materials and equipment with your instructor and class.

8. Attend a lecture-demonstration on safe removal and connections of electrode and ground clamps. Take notes.

   a. Write steps used in the demonstration. Include safety precautions.
   b. Practice the procedure with a classmate.

9. Attend a lecture-demonstration on disassembling, inspecting, replacing, or repairing parts, and reassembling ground clamps and electrodes. Take notes.

   a. Start a Procedures and Tools notebook. Write steps used in the demonstration. Include tools used for each step.
   b. For your instructor, identify defective parts.

   c. From the shop supply area, locate and collect replacement parts.
   d. Practice replacing and/or repairing defective parts.
   e. Practice disassembly, inspection, and reassembly.
   f. Clean up the work area.

10. Perform the procedure for your instructor.

Student Competency Sheet

Unit I: OPERATING SHIELDED METALLIC ARC WELDING EQUIPMENT

Module B: Welding

Task 1: SHIELDED METALLIC ARC-WELD CARBON STEEL

Performance Checklist

1. Select safety equipment.
2. Select tools and materials.
3. Set up equipment.
4. Clean and position for welding.
5. Turn on and adjust welding machine.
6. Weld joints using fillet and groove welds according to work order specifications.

NOTE: Code proficiency requires welding in the following positions:
a. Flat (F&G)
b. Horizontal (2 F&G)
c. Vertical (3 F&G)
d. Overhead (4 F&G)

Test

Items Needed:
1. Sketch specifying carbon steel alloys, dimensions of metals, type of current, and electrodes
2. SMAW machine and accessories
3. Safety equipment
4. Work order
5. Variety of metal specimens (carbon steel alloys, stainless steels, cast iron)
6. Carbon steel alloy workpiece

Task:
1. Weld carbon steel alloy joints according to work order specifications, using the SMAW process.
2. Weld in each of the following positions:
   a. Flat (F&G)
   b. Horizontal (2 F&G)
   c. Vertical (3 F&G)
   d. Overhead (4 F&G)

Standard: Visual inspection of joints will show:
a. Smooth and continuous welds
b. Complete penetration
c. Fusion between the weld bead and base metal
d. No cracks, undercutting or overlap

Learning Activities

1. Read the following:
    a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 6.2-1 to 6.2-24.
    b. Welding Principles and Practices (Sacks), pp. 88-99, 198-201, and 569-634.
    c. Welding Technology (Kennedy), pp. 367-369 and 387-388.

2. Read one (1) of the following:
    a. Electric Arc Welding (Austin), pp. 115-119.
    b. Modern Agricultural Mechanics, pp. 165-167.
    c. New Lessons in Arc Welding (Lincoln Electric Company), pp. 1.7 through 1.10 and 1.18 through 1.34.

3. Study, discuss, and examine examples of:
    a. Information Sheet I-B-1 (Types of Welds).
    b. Information Sheet I-B-1a (Parts of a Weld).
    c. Information Sheet I-B-1b (Types of Joints).
    d. Information Sheet I-B-1c (Direction of Travel).

4. In your Terms Notebook, define terms listed on Information Sheet I-B-1a. Discuss the terms. Examine examples.

5. Attend (a) lecture-demonstration(s) on the differences between and the uses of:
    a. Carbon steel alloys
    b. Heat and corrosion resistant (stainless) steels
    c. Cast iron

6. Identify metals specimens provided by your instructor. Explain the mechanical properties of five (5) of these to your class. Discuss the uses of each.

7. Attend a lecture on sketch interpretation.

8. Read and interpret a sketch provided by your instructor:
    a. Write the specified carbon steel alloy, the dimensions of the metals, the type of current specified, and the electrode(s) to be used.
    b. Write the names of the pieces of safety equipment to be used.

9. Attend a lecture-demonstration of how to make and when to use fillet and groove welds.

10. Observe demonstrations of welding carbon steel in the following positions:

    a. Flat (F&G)
    b. Horizontal (2 F&G)
    c. Vertical (3 F&G)
    d. Overhead (4 F&G)

11. In your Safety Notebook, list:

    a. Five (5) personal safety practices.
    b. Five (5) general shop safety practices.

12. Inspect carbon steel alloy workpieces which have welded joints with cracks, undercutting, and overlap. Discuss with your instructor and class:

    a. The causes of these defects
    b. How to correct the defects
    c. The consequences of not correcting the defects
    d. Mechanical testing of welds

13. Practice making the following fillet and groove welds until your instructor has approved your technique and your work product:

    a. Fillet weld - flat position
    b. Vee groove - flat position (welding a butt joint)
    c. Fillet weld - horizontal position
    d. Square groove - horizontal position (welding a butt joint)
    e. Vee groove - horizontal position (butt weld)
    f. Fillet weld - overhead position (closed corner joint)
    g. Vee groove - overhead position (butt weld)
    h. Vee groove - vertical position (butt joint)

14. Demonstrate the proper procedure for turning on and adjusting the welding machine.

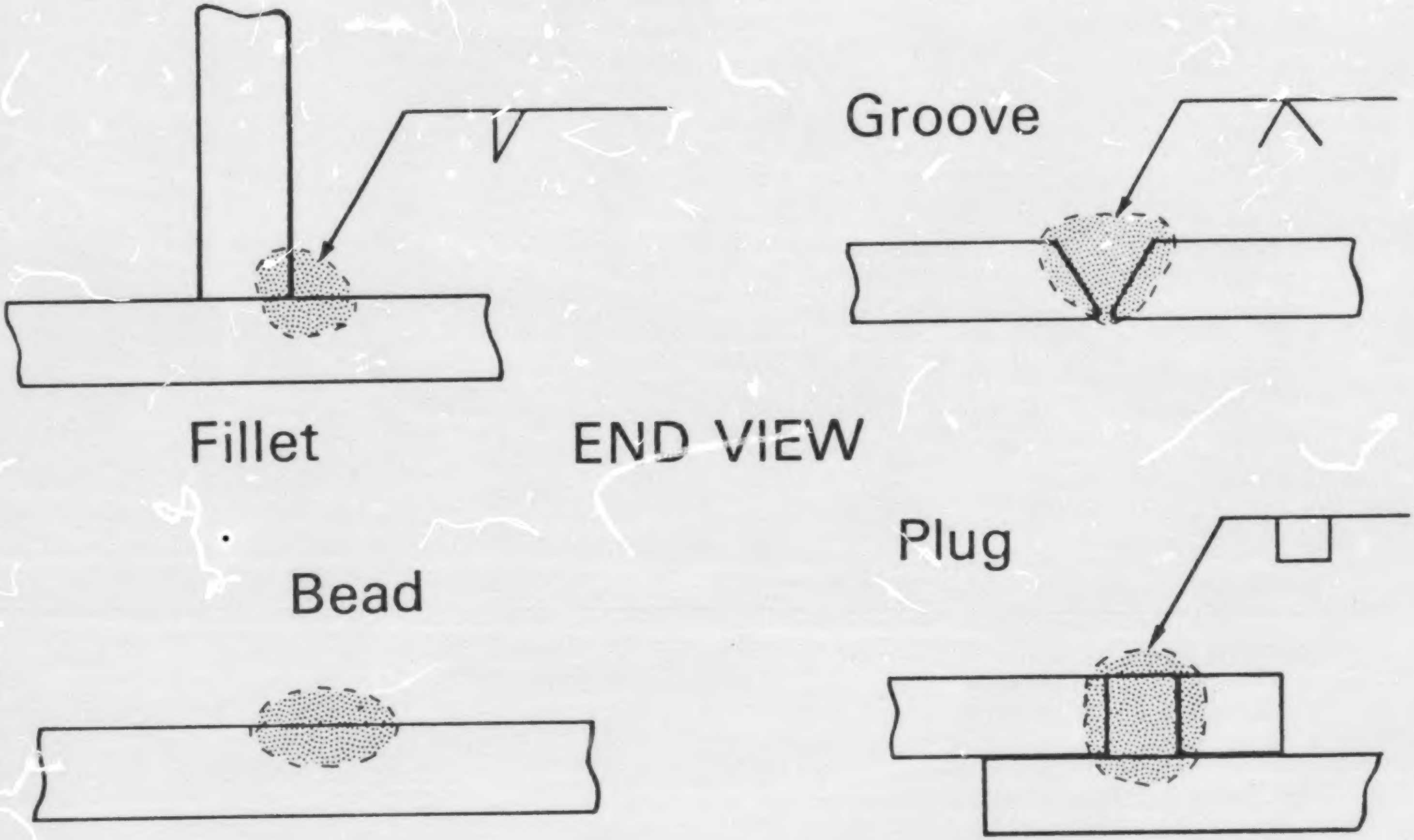
15. Practice welding joints on carbon steel alloy. Make fillet and groove welds in each of the four (4) positions.

    a. Have a classmate inspect your work. Inspect someone else's work.
    b. Discuss criteria for acceptable welds.

16. Practice welding joints on carbon alloy to work order specifications.

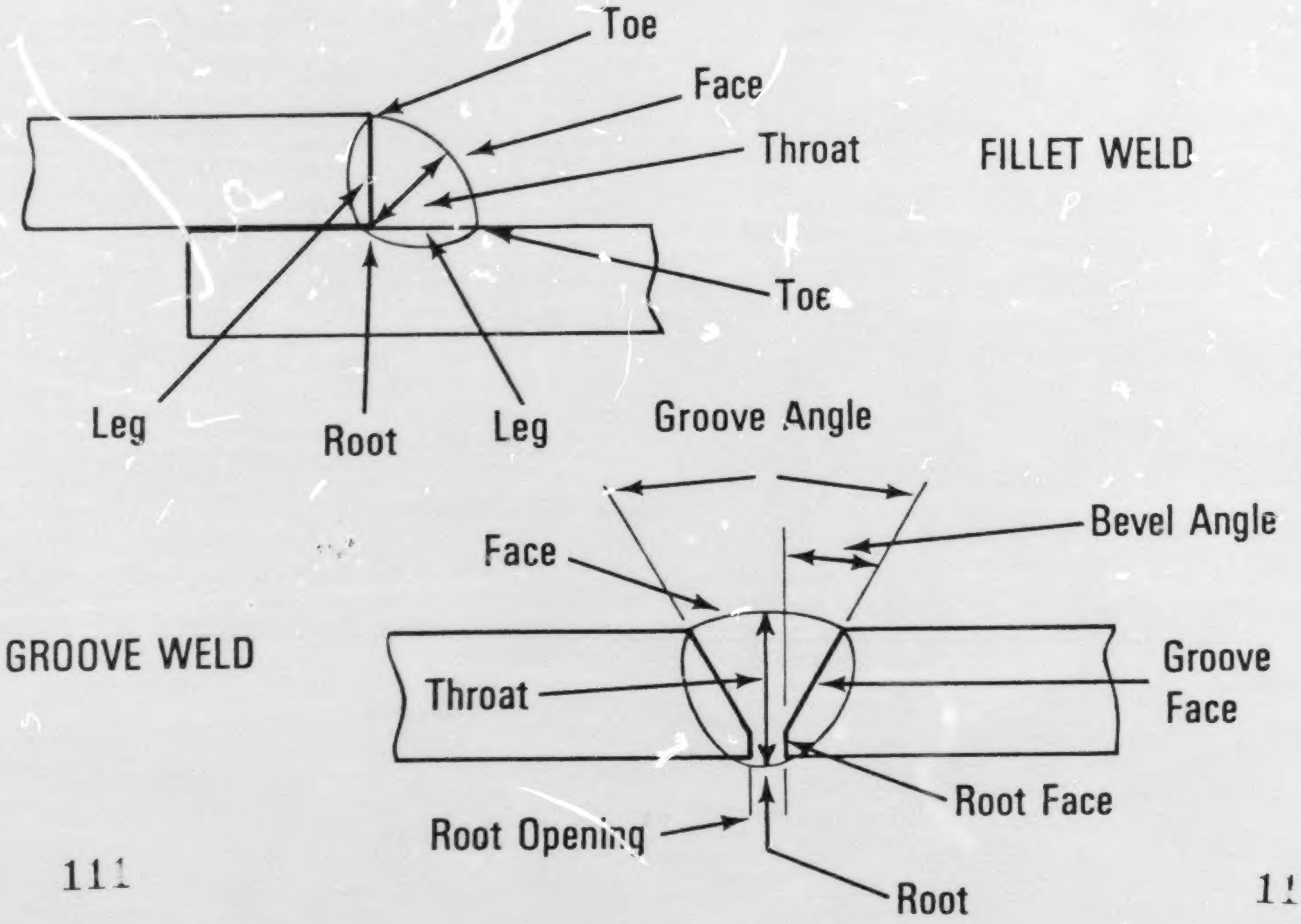
17. Complete a work order to specifications. Have your instructor check your performance.

Types of Welds


Groove
Fillet
END VIEW
Plug
Bead

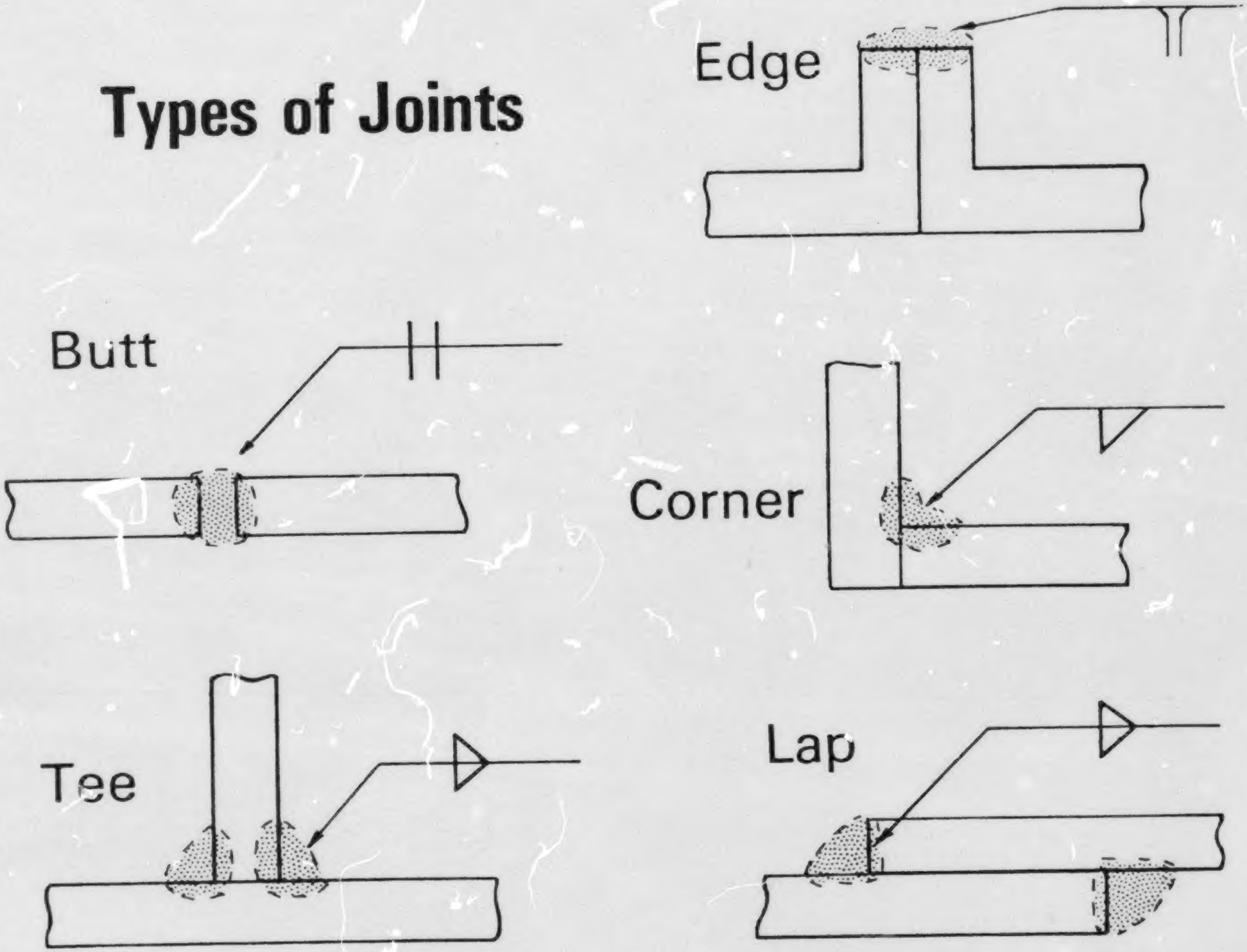
Reprinted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

Parts of a Weld

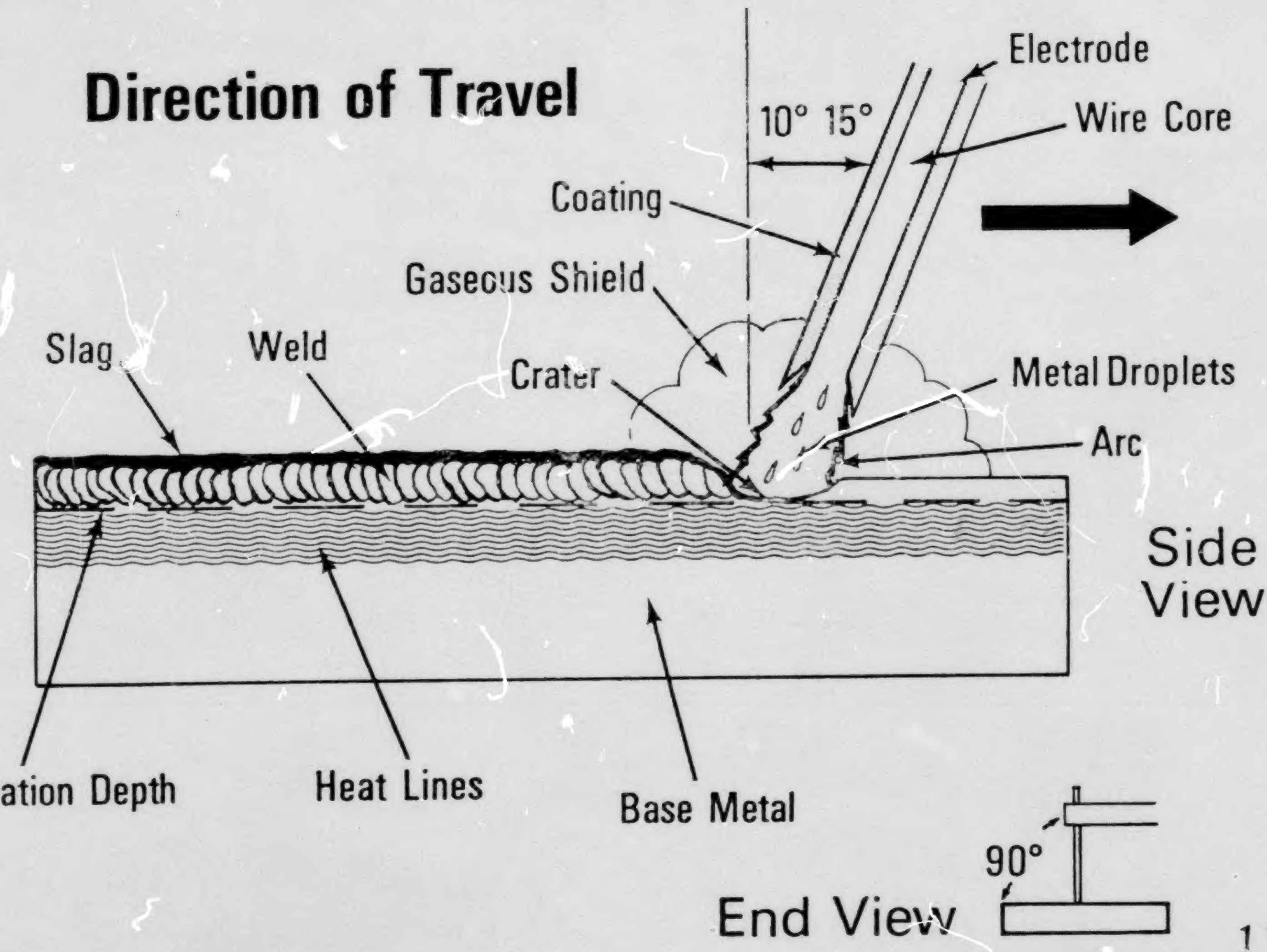

Toe
Face
Throat
FILLET WELD
Toe
Leg
Root
Leg
Groove Angle
Bevel Angle
Face
GROOVE WELD
Throat
Groove Face
Root Face
Root Opening
Root

Reprinted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

Types of Joints



Reprinted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education—Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.


Direction of Travel
10° 15°
Electrode
Wire Core
Coating
Gaseous Shield
Slag
Weld
Crater
Metal Droplets
Arc
Side View
Penetration Depth
Heat Lines
Base Metal
90°
End View

Reprinted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

Information Sheet I-B-1d

Terms

1. Types of weld:
   - a. Fillet
   - b. Groove
   - c. Bead
   - d. Plug
2. Parts of a weld:
   - a. Toe
   - b. Face
   - c. Throat
   - d. Leg
   - e. Root
   - f. Bevel angle
   - g. Root face
   - h. Root opening
   - i. Groove face
3. Types of joints:
   - a. Butt
   - b. Edge
   - c. Corner
   - d. Tee
   - e. Lap
4. Welding Positions:
   - a. Flat
   - b. Vertical
   - c. Horizontal
   - d. Overhead
5. Slag
6. Crater
7. Gaseous shield
8. Base metal
9. Penetration depth
10. Arc
11. Arc length
12. Disposition rate
13. Flux
14. High carbon steel
15. Low carbon steel
16. Mild steel
17. Corrosion resistant steel
18. Pass
19. Porosity
20. Puddle
21. Splatter
22. Tack weld
23. Under cut
24. Weave
25. Weld metal
26. Whipping
27. Fusion
28. String bead
29. Cold lap
30. Arc blow
31. Coupon
32. Slag inclusion
33. Gray iron
34. Cast iron

Student Competency Sheet

Unit I: OPERATING SHIELDED METALLIC ARC WELDING EQUIPMENT

Module B: Welding

Task 2: SHIELDED METALLIC ARC-WELD HEAT AND CORROSION RESISTANT (STAINLESS) STEEL

Performance Checklist

1. Select safety equipment.
2. Select tools and materials.
3. Set up equipment.
4. Clean and position for welding.
5. Turn on and adjust welding machine.
6. Weld joints, using fillet and groove welds according to work order specifications.

NOTE: Code proficiency requires welding in the following positions:
   a. Flat (F&G)
   b. Horizontal (2 F&G)
   c. Vertical (3 F&G)
   d. Overhead (4 F&G)

Test

Items Needed:
1. Sketch specifying heat and corrosion resistant (stainless) steels, dimensions of metal, type of current, and electrodes
2. SMAW machine and accessories
3. Safety equipment
4. Work order
5. Stainless steel

Task:
1. Weld stainless steel joints according to work order specifications using the SMAW process.
2. Welding must be performed in each of the following positions:
   a. Flat (F&G)
   b. Horizontal (2 F&G)
   c. Vertical (3 F&G)
   d. Overhead (4 F&G)

Standard: Visual inspection of joints will show:
   a. Smooth and continuous welds
   b. Complete penetration
   c. Fusion between the weld bead and base metal
   d. No cracks, undercutting or overlap

Learning Activities

1. Read the following:
    a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 7.1-1 through 7.1-11 and 7.2-2 through 7.2-6.
    b. Welding Principles and Practices (Sacks), pp. 96-98.
2. Read one (1) of the following:
    a. Electric Arc Welding (Austin), pp. 128-131.
    b. New Lessons in Arc Welding (Lincoln Electric Company), pp. 4.1 and 4.2.
    c. Welding Technology (Kennedy), pp. 370 and 380 to 387.
3. Review Information Sheet I-B-1d (Terms).
4. Read a sketch provided by your instructor.
    a. Write the specified heat and corrosion resistant (stainless) steels, the dimensions of the metals, the type of current specified, and the electrode(s) to be used.
    b. Write the names of the pieces of safety equipment to be used.
5. Observe demonstrations of welding heat and corrosion resistant (stainless) steels in the following positions:
    a. Flat (F&G)
    b. Horizontal (2 F&G)
    c. Vertical (3 F&G)
    d. Overhead (4 F&G)
6. In your Safety Notebook, list:
    a. Five (5) personal safety practices.
    b. Five (5) general shop safety practices.
7. Inspect stainless steel workpieces which have welded joints with cracks, undercutting, and overlap. Discuss with your instructor and class:
    a. The causes of these defects
    b. How to correct the defects
    c. The consequences of not correcting the defects
    d. Mechanical testing of welds
8. Practice welding joints on stainless steel. Make fillet and groove welds in each of the four (4) positions.
    a. Have a classmate inspect your work. Inspect someone else's work.
    b. Discuss acceptable and unacceptable criteria.

9. Practice welding joints on stainless steel to work order specifications.

10. Weld stainless to specs of a work order provided by your instructor. Submit your finished work piece to the instructor for evaluation.

Student Competency Sheet

Unit I: OPERATING SHIELDED METALLIC ARC WELDING EQUIPMENT

Module B: Welding

Task 3: SHIELDED METALLIC ARC-WELD CAST IRON

Performance Checklist

1. Select safety equipment.
2. Inspect broken casting to determine degree of bevel and prepare.
3. Inspect to determine need for machinable or non-machinable electrodes and select.
4. Align parts in original position and select the appropriate clamp(s) for welding.
5. Weld the casting.
6. Grind excessive metal, if required.

Test

Items Needed:
1. Work order
2. SMAW unit
3. Section of broken cast iron
4. Safety equipment
5. Clamps
6. Grinding equipment

Task: Arc-weld cast iron using the SMAW process.

Standard:
1. The repaired casting must conform to its original configuration and strength.
2. Your instructor will perform an operational check on the repaired casting.

Learning Activities

1. Read the following:
   - a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 8.1-1 through 8.1-6.
   - b. Electric Arc Welding (Austin), pp. 120-128.
2. Read one (1) of the following:
   - a. New Lessons in Arc Welding (Lincoln Electric Company), pp. 1.36 and 7.19 to 7.25.
   - b. Welding Skills and Practices (Giachino/Weeks), pp. 125-133.
   - c. Welding Technology (Kennedy), pp. 372-373 and 389-392.

3. See and discuss overhead transparency "Cast Iron Welding," D.C.A. Arc Welding, No. W-51.

4. Review Information Sheet I-B-1d (Terms).

5. Attend a lecture-demonstration on how to determine the necessary degree of bevel on a broken casting.

6. Attend a lecture-demonstration on how to prepare a broken casting for repair.

7. Practice beveling to instructor's specifications.

8. Discuss suitable uses for machinable and non-machinable electrodes.

9. Obtain a work order from the instructor. Select the appropriate electrodes for the repair operation indicated by the work order.

10. In your Safety Notebook, list:

    a. Five (5) personal safety practices
    b. Five (5) general shop safety practices

11. Attend a lecture-demonstration on the uses of clamps.

    a. From the storage area, select a variety of clamps.
    b. Identify each clamp by name and use. Write your list and have your instructor inspect your list.
    c. Select the proper clamp(s) for the workpiece specified in the work order in Learning Activity 9.
    d. Put unused clamps back into proper storage compartment(s).

12. Prepare a broken cast iron section for welding. Demonstrate the procedure for aligning and clamping the broken sections.

13. Practice the welding procedure.

14. Observe a demonstration on grinding excessive metal.

15. Practice the grinding procedure.

16. Prepare and weld a cast iron section. Submit your finished work piece to the instructor for evaluation.

Student Competency Sheet

Unit I: OPERATING SHIELDED METALLIC ARC WELDING EQUIPMENT

Module C: Cutting and Build-up/Hard Surfacing

Task 1: HARD SURFACE STEEL WITH ARC-WELDING EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Study job sheet to determine:
   a. Use of work piece.
   b. Type of bead pattern.
   c. Type of facing alloy and/or building materials.
3. Clean work piece.
4. Apply beads. (Preheat if required.)
5. Finish surface to work order specifications.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Arc-welding equipment
4. Steel work piece
5. Equipment and materials indicated by work order
6. Facing alloy and/or build-up materials

Task: Build up or hard surface a piece of steel.

Standard: Build up or hard surface on steel work piece must meet the specifications in the work order.

Learning Activities

1. Read one (1) of the following:
   a. Electric Arc Welding (Austin), pp. 141-167.
   b. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 13.7-1 through 13.7-20.
   c. Welding Principles and Practices (Sacks), pp. 539-542.
2. Read one (1) of the following:
   a. New Lessons in Arc Welding (Lincoln Electric Company), pp. 1.42 and 5.1 through 5.6.
   b. Welding Skills and Practices (Giachino/Weeks), pp. 312-323.
   c. Welding Technology (Kennedy), pp. 563-585.
3. Attend a lecture-demonstration on facing alloys and build-up materials.

4. Discuss types, uses, and selection of facing alloys and build-up materials.

5. Identify facing alloys (provided by your instructor) by trade names and uses.

6. Attend a lecture-demonstration on uses of various types of beads.

7. Attend lecture demonstrations on laying the following types of beads:

   a. Continuous beads - in the flat position
   b. Wash beads - in the flat position
   c. Continuous beads (padding) - in the horizontal position
   d. Wash beads - in the horizontal position
   e. Outside corner joint-stringer beads - in the horizontal position
   f. Continuous bead pad - in the overhead position
   g. Weave and wash bead (without a backup strip) - in the overhead position
   h. Continuous bead (padding) - in the vertical position
   i. Weave and wash bead (without backup strip) - to weld a butt joint in the vertical position

8. In your Safety Notebook, list:

   a. Five (5) personal safety practices
   b. Five (5) general shop safety practices
   c. Safety equipment needed to lay beads

9. Practice laying each of the beads listed above (Learning Activity 7). Your instructor will specify the electrode, work piece, and facing alloy(s) to be used.

10. Identify, and list in the Safety Notebook, safety hazards involved in applying build-up or hard surface.

11. Working from a job sheet, practice the procedure to build up or hard surface a piece of steel with arc-welding equipment.

12. Obtain a work sheet from your instructor. Build up or hard surface on a steel work piece. Submit your finished work piece to your instructor for evaluation.

Student Competency Sheet

Unit I: OPERATING SHIELDED METALLIC ARC WELDING EQUIPMENT

Module C: Cutting and Build-up/Hard Surfacing

Task 2: CUT CARBON STEEL USING SHIELDED METALLIC ARC CUTTING PROCESS

Performance Checklist

1. Measure and mark metal.
2. Select safety equipment.
3. Select electrodes.
4. Set up and adjust machine.
5. Position metal.
6. Perform the cut.

Test

Items Needed:
1. Work order requiring carbon steel cutting by the SMAC process
2. Safety equipment
3. Arc-welding equipment
4. Carbon steel work piece
5. Equipment and materials indicated by work order
6. E6011 or E6010 electrodes
7. Steel rule
8. Marking pencil

Task: Cut carbon steel, according to work order, using SMAC process.

Standard: Metal must be cut to ± 1/8 inch (3mm) of work order specifications using E6010 or E6011 electrodes.

Learning Activities

1. Read:
   a. Welding Principles and Practices (Sacks), pp. 235-349.
   b. Welding Technology (Kennedy), p. 414.
   c. Welding Skills and Practices (Giachino/Weeks), pp. 343-345.
2. View Transparency W-26 from D.C.A. set - Arc Welding.
3. Observe a demonstration by the instructor.

4. List in Safety Notebook:
    - a. Five (5) personal safety practices.
    - b. Five (5) general shop safety practices.
    - c. Safety equipment needed.

5. Practice cutting carbon steel with shielded arc.

6. Obtain work order from your instructor:
    - a. Obtain material specified.
    - b. Set up SMAW equipment.
    - c. Cut.
    - d. Submit the finished work piece to your instructor for evaluation.

Student Competency Sheet

Unit I: OPERATING SHIELDED METALLIC ARC WELDING EQUIPMENT

Module C: Cutting and Build-up/Hard Surfacing

Task 3: CUT CARBON STEEL WITH AIR CARBON ARC PROCESS

Performance Checklist

1. Select safety equipment.
2. Measure and mark metal.
3. Select carbon electrodes.
4. Set up and adjust machine and air.
5. Position metal.
6. Cut and gouge.

Test

Items Needed:
1. Work order requiring carbon steel cutting and gouging by the air carbon arc process
2. Safety equipment
3. Air carbon arc welding equipment
4. Tools and equipment indicated by work order
5. Carbon steel work piece
6. Measuring instrument
7. Marker

Task: Cut and gouge carbon steel, according to the work order, using the air carbon arc cutting process.

Standard: Metal must be cut and gouged to ± 1/8 inch (3mm) of work order specifications.

Learning Activities

1. Read:
   - a. Welding Principles and Practices (Sacks), pp. 238-240.
   - b. Welding Skills and Practices (Giachino/Weeks), pp. 348-351.
   - c. Welding Technology (Kennedy), pp. 406-411.
2. Observe a demonstration by instructor of:
   - a. Cutting carbon steel by air carbon arc.
   - b. Gouging carbon steel by air carbon arc.
3. List in Safety Notebook:
   - a. Five (5) personal safety practices.
   - b. Five (5) general shop safety practices.
   - c. Safety equipment needed.

4. Practice air arc cutting and gouging on carbon steel.

5. Obtain work order from instructor:

   a. Obtain material specified.
   b. Set up equipment.
   c. Cut to specs.
   d. Submit the finished work piece to your instructor for evaluation.

Student Competency Sheet

Unit I: OPERATING SHIELDED METALLIC ARC WELDING EQUIPMENT

Module C: Cutting and Build-up/Hard Surfacing

Task 4: CUT CAST IRON WITH AIR CARBON ARC PROCESS

Performance Checklist

1. Select safety equipment
2. Measure and mark metal.
3. Select carbon electrodes.
4. Set up and adjust machine and air.
5. Position metal.
6. Cut and gouge.

Test

Items Needed:

1. Work order requiring cast iron cutting and gouging by air carbon arc process
2. Safety equipment
3. Shielded metallic arc welding equipment
4. Carbon electrodes
5. Cast iron work piece
6. Measuring instrument
7. Marker

Task: Cut and gouge cast iron, according to work order, using the air carbon arc cutting process.

Standard: Cast iron must be cut and gouged to ± 1/8 inch (3mm) of work order specifications.

Learning Activities

1. Read:
   a. Welding Principles and Practices (Sacks), pp. 238-240.
   b. Welding Skills and Practices (Giachino/Weeks), pp. 348-350.
   c. Welding Technology (Kennedy), pp. 408-411.
2. Observe demonstration by instructor.
3. List in Safety Notebook:
   a. Five (5) personal safety practices.
   b. Five (5) general shop safety practices.
   c. Safety equipment needed.

4. Practice air-arc cutting cast iron.

5. Obtain work order from instructor:

    a. Obtain material specified.
    b. Set up equipment.
    c. Cut to specifications.
    d. Submit for evaluation by instructor.

UNIT II

OPERATING GAS WELDING EQUIPMENT

Terminal Objectives

Upon completion of the modules in this unit, you will:

- Set up portable or stationary oxy-fuel equipment
- Change oxygen, acetylene or MAPP gas cylinders
- Clean welding and cutting tips on oxy-fuel equipment
- Perform a soap and water and/or submerged leak test
- Repair gas welding equipment
- Cut carbon steels with oxy-acetylene equipment
- Forge metals with gas equipment
- Shape metals, using gas welding equipment
- Remove distortion, using gas welding equipment
- Braze ferrous and non-ferrous metals with gas equipment
- Silver braze ferrous and non-ferrous metals with gas equipment
- Lead solder ferrous and non-ferrous metals with gas equipment
- Gas weld carbon steels
- Gas weld cast iron
- Gas weld copper or copper alloys
- Braze weld carbon steel
- Braze repair cast iron castings

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module A: Equipment Set-up and Maintenance

Task 1: SET UP PORTABLE OR STATIONARY OXY-FUEL EQUIPMENT

Performance Checklist

1. Chain cylinders to cart.
2. Remove cylinder caps.
3. Crack cylinder valves to clean out foreign particles and inspect threads.
4. Attach pressure regulator gauge to cylinders and purge:
   a. Left-hand thread on gas regulator.
   b. Right-hand thread on oxygen regulator.
5. Inspect threads of check valve system, if used.
6. Install check valves and purge.
7. Inspect threads on hose fittings:
   a. Acetylene gas hoses are red and have left-hand threads.
   b. Oxygen hoses are green and have right-hand threads.
8. Attach hoses to regulators and purge system.
9. Inspect threads of torch:
   a. Gas - left-hand thread.
   b. Oxygen - right-hand thread.
10. Attach hoses to torch.
11. Check for leaks.

Test

Items Needed:
1. Safety equipment
2. Oxy-acetylene torch
3. Oxygen regulator
4. Gas regulator
5. Hoses
6. Check valves
7. Cylinder wrench
8. Oxygen
9. Fuel cylinders
10. Portable cart

Task:
1. Set up a portable or stationary oxy-fuel outfit.
2. Check oxy-fuel equipment for leaks.

Standard:
1. Oxy-fuel equipment will not leak.
2. Oxy-fuel equipment will operate safely, as specified by the manufacturer.

Learning Activities

1. Read one (1) of the following:

   a. Welding Principles and Practices (Sacks), pp. 139-164.
   b. Welding Technology (Kennedy), pp. 153-223.

2. Read one (1) of the following:

   a. Gas Welding (Giachino), pp. 1-21.
   b. Modern Welding (Althouse/Turnquist/Bowditch), pp. 1-9 to 1-14 and 2-1 to 2-28.
   c. Welding Skills and Practices (Giachino/Weeks), pp. 238-259.

3. Write answers to one of the following:

   a. Welding Principles and Practices (Sacks), Review Questions, pp. 163-164.
   b. Welding Technology (Kennedy), Review Questions, pp. 222-223.

4. Observe demonstration by instructor.

5. Read Information Sheets II-A-1 (Terms) and II-A-1a (Safety Practices).

6. Read Information Sheets II-A-1b and II-A-1c.

   a. With your class, discuss the consequences of not following each of 14 safety procedures. (Information Sheet II-A-1b)
   b. Locate the diagrammed items on your own shop equipment. (Information Sheet II-A-1c)

7. Study and inspect equipment illustrated in:

   a. Information Sheet II-A-1d (Parts of a Torch Body and Cutting Attachment)
   b. Information Sheet II-A-1e (Oxyacetylene Welding Equipment)
   c. Information Sheet II-A-1f (Welding Torches)
   d. Information Sheet II-A-1g (Welding Regulators)
   e. Information Sheet II-A-1h (Oxyacetylene Fusion Welding Flames)

8. Enter new terms and definitions in your notebook.

9. List in your Safety Notebook:

   a. Five (5) personal safety practices.
   b. Five (5) general area safety practices.

10. In the Procedure Notebook, write the procedure for shutting down the system for:

    a. Short period of time (one (1) to ten (10) minutes)
    b. Several hours
    c. Overnight

11. Set up oxy-fuel system and explain procedure to instructor. Include the following:

    a. Safety
    b. Leak check
    c. Selection of torch tip
    d. Setting pressure
    e. Igniting torch and adjusting to neutral flame
    f. Shut down

12. In the Procedure Notebook, write a procedure for prevention and correction of:

    a. Leaking cylinders
    b. Leaking pressure regulators
    c. Leaking hoses
    d. Leaking torches

13. In the presence of your instructor, set up oxy-fuel equipment, check for leaks, and shut down the equipment for the time specified by the instructor.

Information Sheet II-A-1

Terms

1. Flashback
2. Backfire
3. Flame Cutting
4. Slag box
5. Drag line
6. Kerf
7. Oxide
8. Oxidizing
9. Oxygen fitting
10. Acetylene fitting
11. Torch body
12. Preheat flame
13. Preheat orifice
14. Cutting oriface
15. Acetylene torch valve
16. Oxygen torch valve
17. Oxygen preheat valve
18. Fusion welding
19. Penetration
20. Base metal
21. Alloy
22. Inner cone
23. Tack weld
24. Blow handle
25. Oxygen regulator
26. Acetylene regulator
27. Carburizing flame
28. Neutral flame
29. Oxidizing flame
30. Braze welding
31. Malleability
32. Ductile
33. Tinning operation
34. Flux
35. Brazing
36. Ferrous
37. Non-ferrous
38. Soldering
39. Distortion
40. Cracking valves
41. Purge

Information Sheet II-A-1a

Safety Practices

1. If heavy smoke comes out of torch tip and the torch body becomes hot, flashback has probably traveled past the mixing chamber into the hose. Shut off the oxygen cylinder valve and the acetylene cylinder torch, and notify instructor immediately.

2. Support oxygen and acetylene cylinders in an upright position so they cannot be tipped over.

3. Acetylene gas is in a liquid state in the cylinder. It should be used in vertical position.

4. Blow out cylinder valves to remove dust or dirt that may damage regulators.

5. Release pressure adjusting screw on regulator before opening cylinder valves in order to prevent damage to regulator and possible injury to operator.

6. When opening cylinder valves, stand to the side of regulators. Keep the cylinder valve between operator and regulator.

7. Open cylinder valves slowly.

8. Do not use acetylene at pressures higher than 15 psi. (Acetylene becomes unstable at pressures above 15 psi.)

9. Purge oxygen and acetylene passages individually before lighting torch.

10. Light acetylene before opening oxygen torch valve.

11. Never use oil or grease on regulator, torches, or fittings. Oil or grease and oxygen have a very great affinity for one another and will unite with explosive violence.

12. Do not use oxygen as a substitute for compressed air.

13. Use safety goggles, gloves, and protective clothing.

14. Be sure CO_2 or dry chemical-type fire extinguisher is available.

15. Test connections for leaks.

16. Do not light torch or cut near combustible materials.

17. Never open the acetylene cylinder valves more than 1/2 to 3/4 turns.

18. Always operate torch in well-ventilated area.

19. Never cut on containers that have been used for combustible materials.

20. Avoid breathing toxic fumes when cutting.

21. To protect the valves, place steel caps on all gas cylinders when they are being moved or stored.

22. Shut off cylinder valves when not in use for any length of time to reduce leakage and strain on the equipment.

23. Turn acetylene torch valves off first so that the flame will go out immediately.

24. Keep hands, gloves, and clothing free of oil and grease.

25. Never cut or weld too close to concrete.

26. Always weld or cut at least five (5) feet away from cylinders.

27. Always protect hoses from hot metal, rupture, or mechanical damage.

28. Always light torch with friction lighter.

29. Never leave a burning torch unattended.

Adapted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

Information Sheet II-A-1b

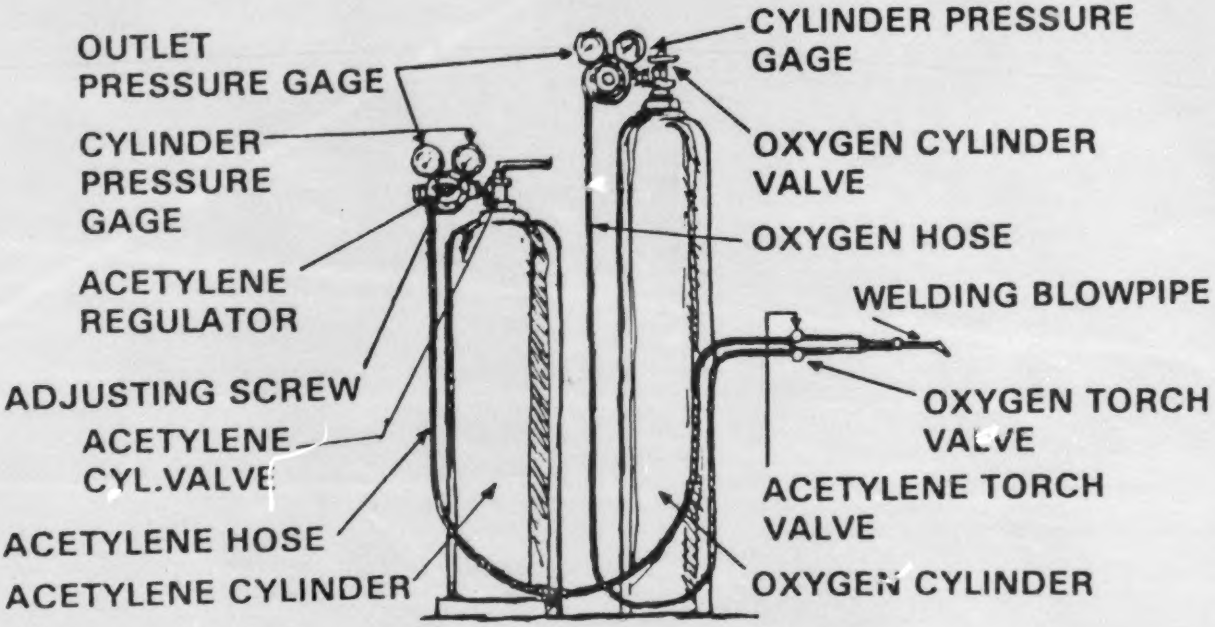
Safety for the Oxy-Acetylene Welder

1. OPERATE ONLY WITH INSTRUCTOR'S PERMISSION AND AFTER YOU HAVE RECEIVED INSTRUCTION.
2. REMOVE JEWELRY, ELIMINATE LOOSE CLOTHING, AND CONFINE LONG HAIR.
3. MAKE SURE ALL GUARDS ARE IN PLACE AND OPERATING CORRECTLY.
4. ALWAYS USE PROPER EYE PROTECTION.
5. Do not allow oil to come in contact with hoses or equipment.
6. Gas bottles must be erect and secure at all times.
7. Keep the cylinder caps on the bottles when not in use.
8. Protective goggles and spark-resistant clothing must be worn when welding.
9. Confine all cutting and welding to the designated area in the shop.
10. Do not weld galvanized metal without proper ventilation.
11. Do not weld or cut on a closed container without instructor's approval.
12. The acetylene must never exceed 15 psi outlet pressure.
13. Turn off torch valves when finished with equipment.
14. Turn off gas and oxygen at tanks or stations at the end of class session.

Reprinted from: Pennsylvania Industrial Arts Safety Guide, Pennsylvania Department of Education, Industrial Arts Association of Pennsylvania, 1978.

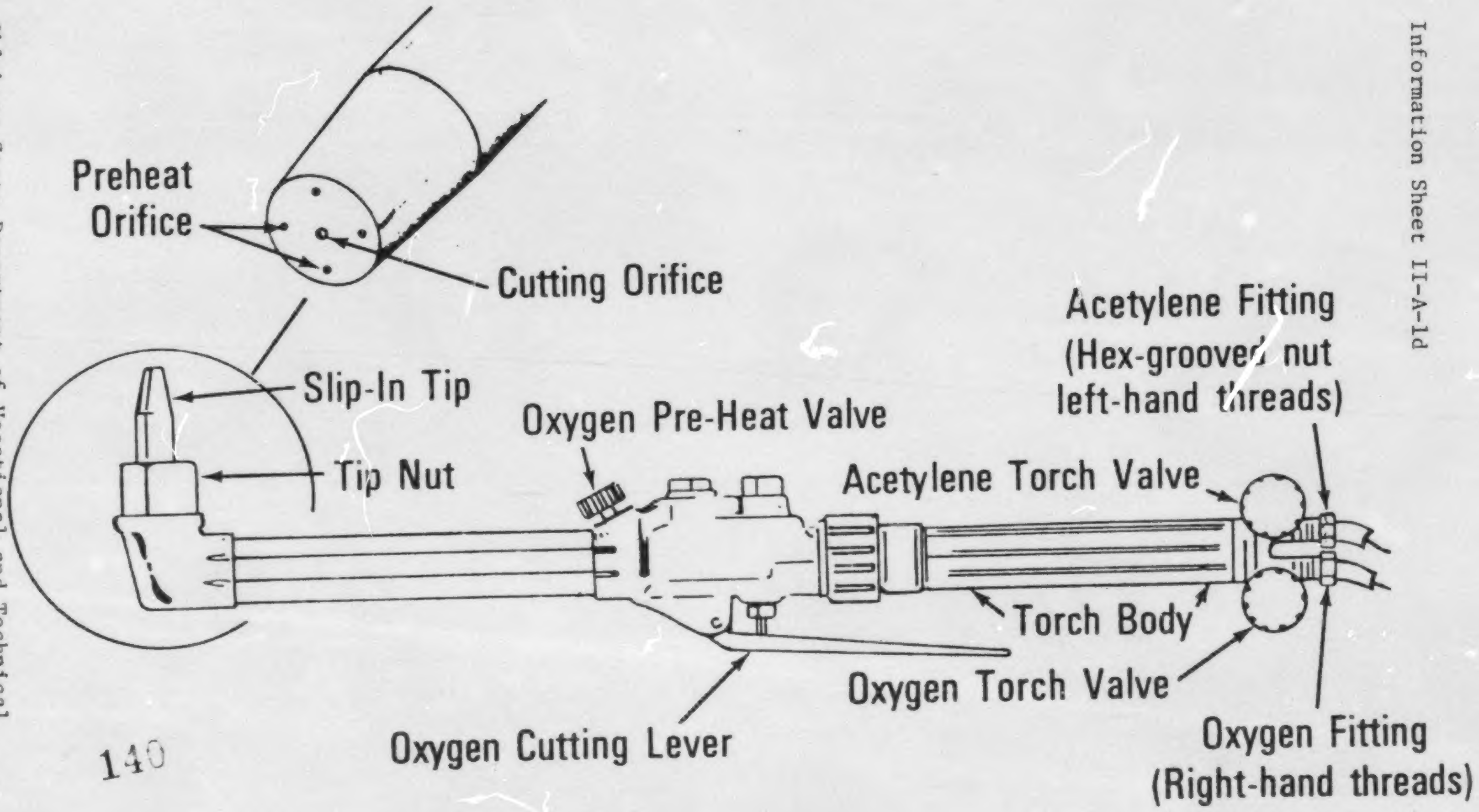
Information Sheet II-A-1c

Oxy-Acetylene Welder


CYLINDER PRESSURE GAGE
OUTLET PRESSURE GAGE
CYLINDER PRESSURE GAGE
OXYGEN CYLINDER VALVE
OXYGEN HOSE
ACETYLENE REGULATOR
WELDING BLOWPIPE
ADJUSTING SCREW
OXYGEN TORCH VALVE
ACETYLENE CYL.VALVE
ACETYLENE TORCH VALVE
ACETYLENE HOSE
ACETYLENE CYLINDER
OXYGEN CYLINDER

Reprinted from: Pennsylvania Industrial Arts Safety Guide, Pennsylvania Department of Education, Industrial Arts Association of Pennsylvania, 1978.

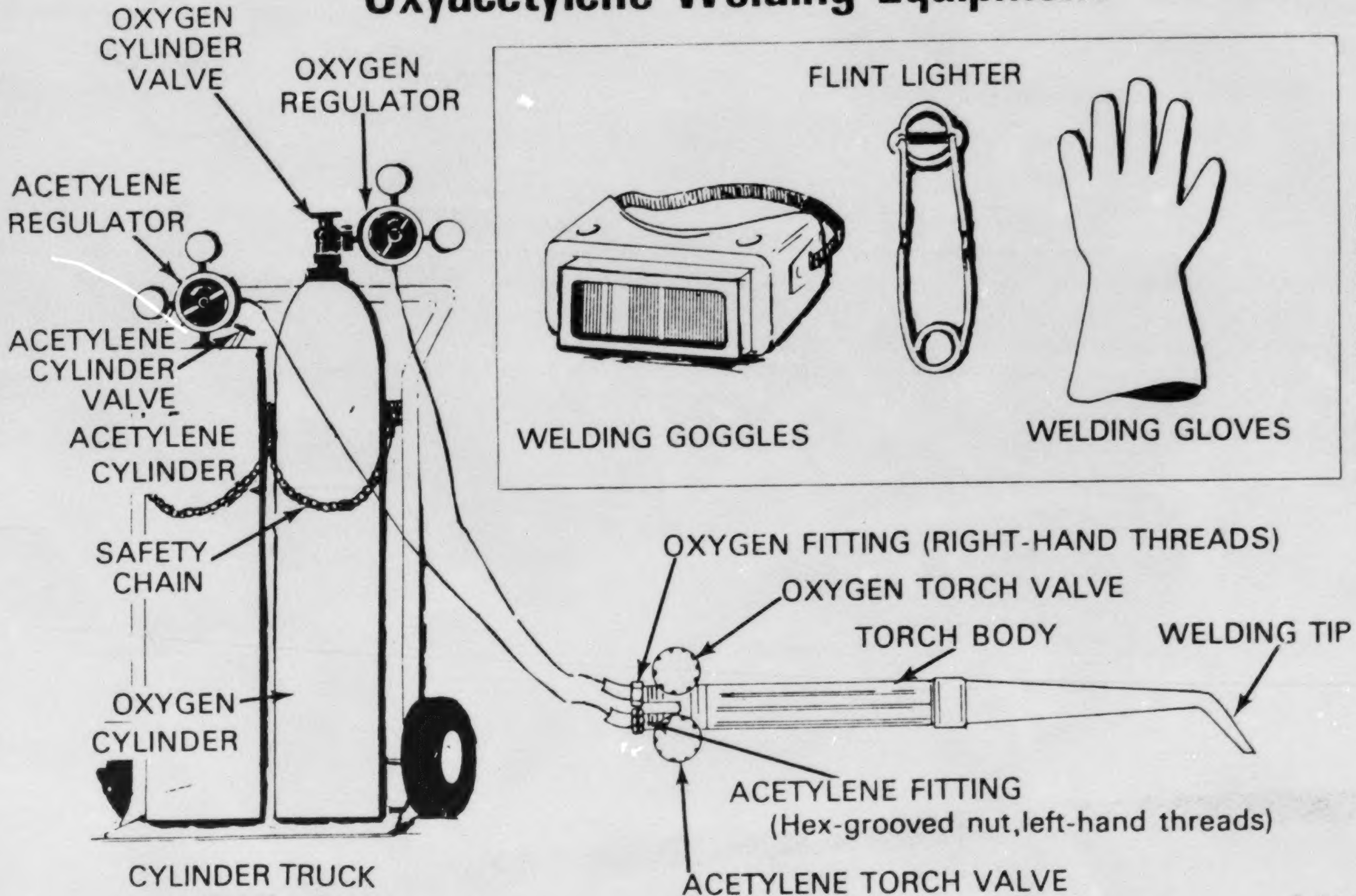
Parts of a Torch Body and Cutting Attachment


Preheat Orifice
Cutting Orifice
Slip-In Tip
Tip Nut
Oxygen Pre-Heat Valve
Acetylene Fitting (Hex-grooved nut left-hand threads)
Acetylene Torch Valve
Torch Body
Oxygen Torch Valve
Oxygen Cutting Lever
Oxygen Fitting (Right-hand threads)

Reprinted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

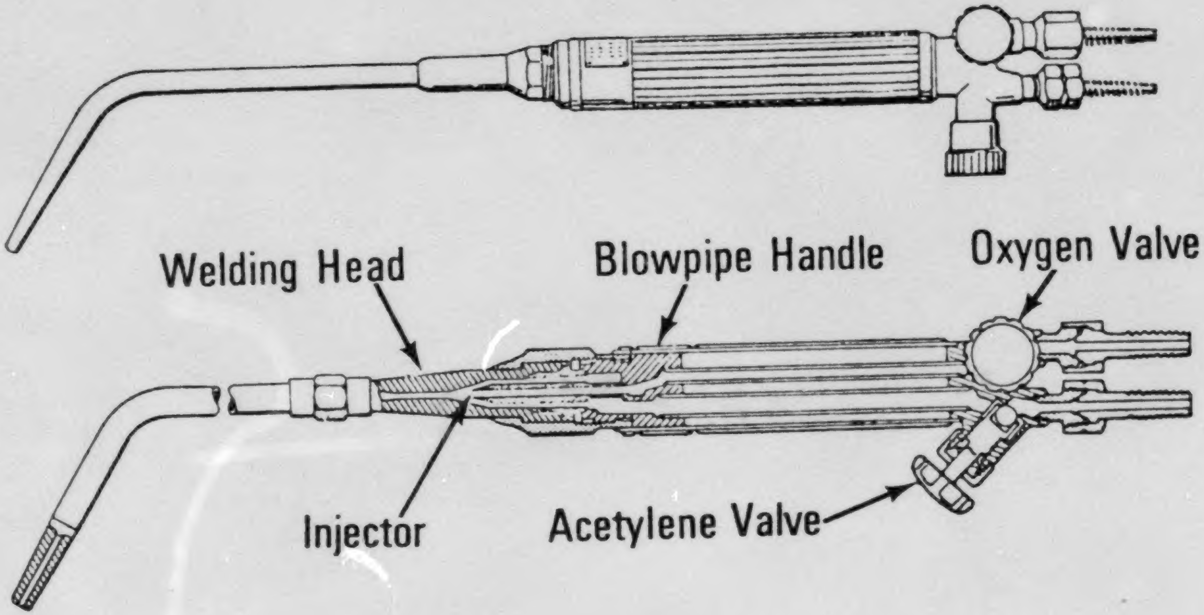
Reprinted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

Oxyacetylene Welding Equipment


OXYGEN CYLINDER VALVE
OXYGEN REGULATOR
ACETYLENE REGULATOR
ACETYLENE CYLINDER VALVE
ACETYLENE CYLINDER
SAFETY CHAIN
OXYGEN CYLINDER
CYLINDER TRUCK
FLINT LIGHTER
WELDING GOGGLES
WELDING GLOVES
OXYGEN FITTING (RIGHT-HAND THREADS)
OXYGEN TORCH VALVE
TORCH BODY
WELDING TIP
ACETYLENE FITTING (Hex-grooved nut,left-hand threads)
ACETYLENE TORCH VALVE

Information Sheet II-A-1e

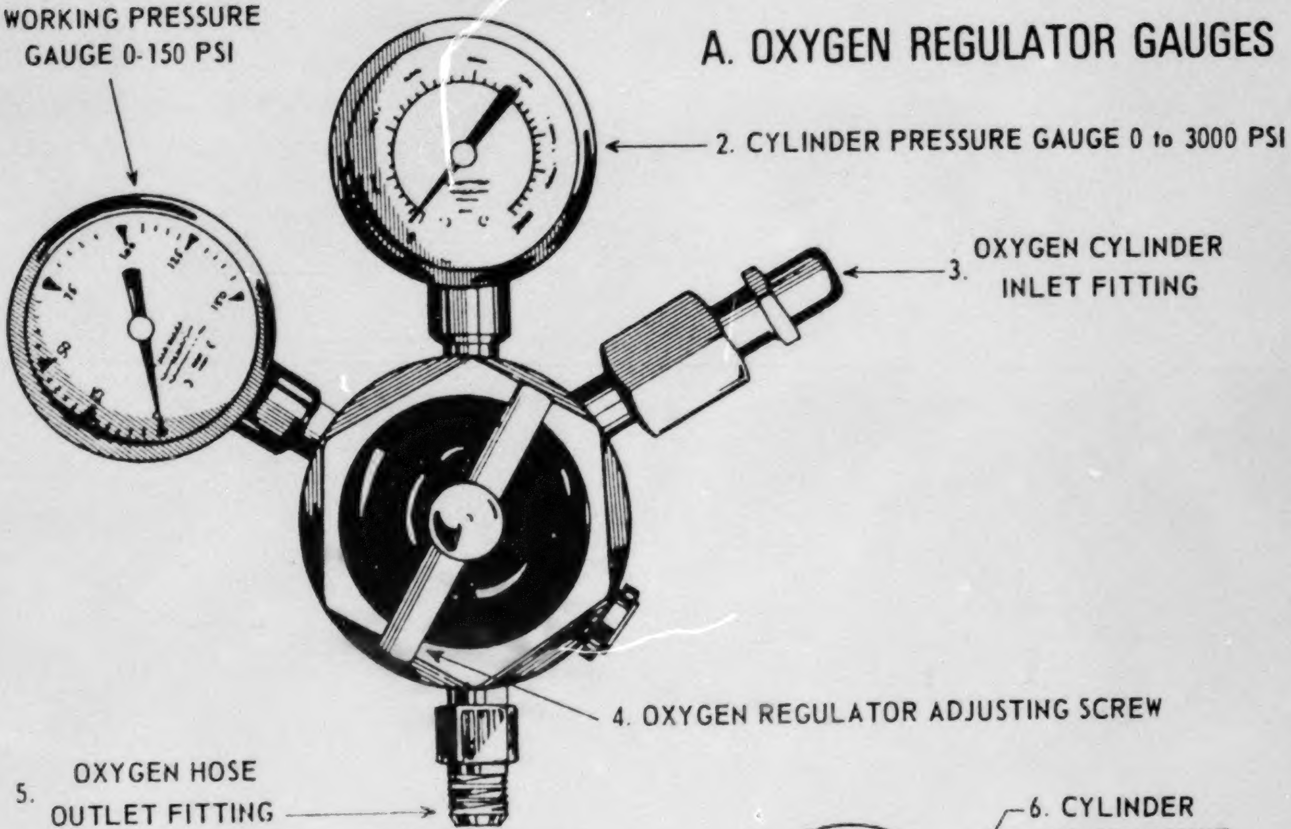
Welding Torches


Welding Head
Blowpipe Handle
Oxygen Valve
Injector
Acetylene Valve

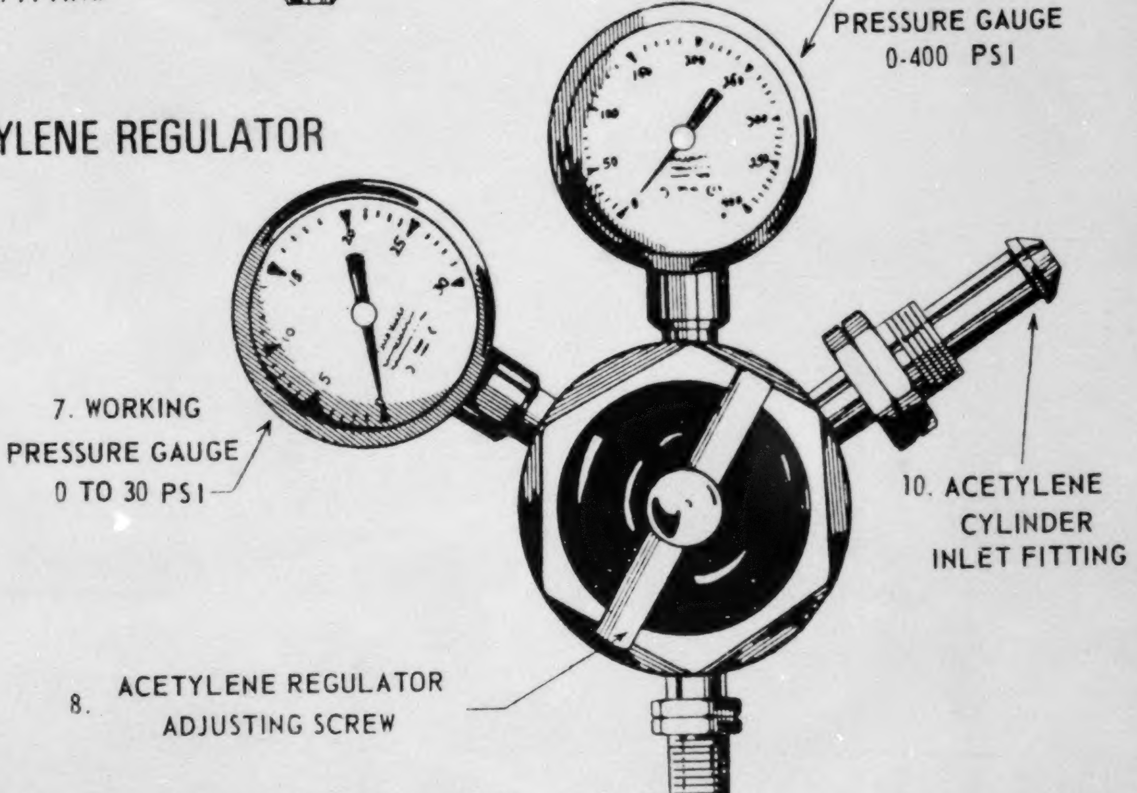
Reprinted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

Welding Regulators

A. OXYGEN REGULATOR GAUGES


1. WORKING PRESSURE GAUGE 0-150 PSI
2. CYLINDER PRESSURE GAUGE 0 to 3000 PSI
3. OXYGEN CYLINDER INLET FITTING
4. OXYGEN REGULATOR ADJUSTING SCREW
5. OXYGEN HOSE OUTLET FITTING

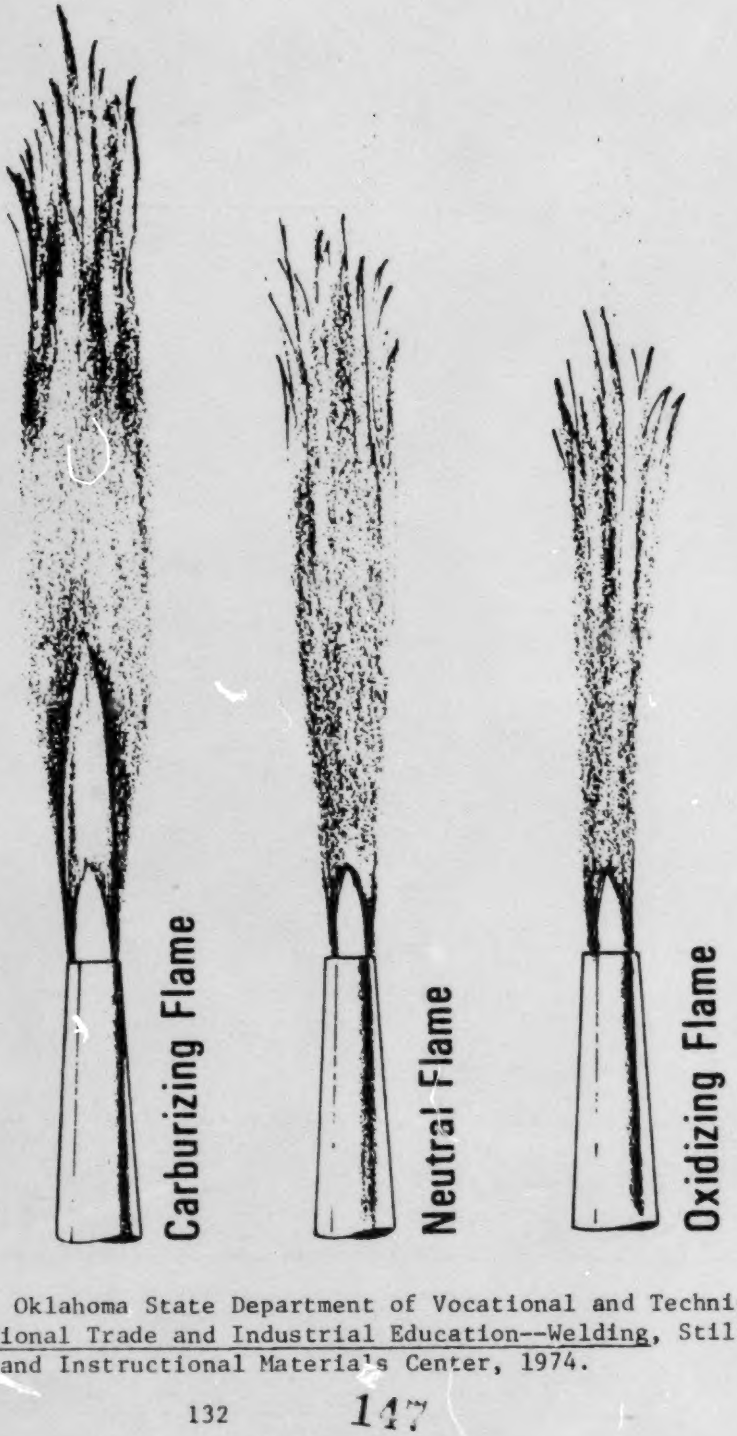
B. ACETYLENE REGULATOR


6. CYLINDER PRESSURE GAUGE 0-400 PSI
7. WORKING PRESSURE GAUGE 0 TO 30 PSI
8. ACETYLENE REGULATOR ADJUSTING SCREW
9. ACETYLENE HOSE OUTLET FITTING
10. ACETYLENE CYLINDER INLET FITTING

Reprinted from: Oklahoma State Department
of Vocational and Technical Education,
Vocational Trade and Industrial Education--
Welding, Stillwater, OK: Curriculum and
Instructional Materials Center, 1974

Information Sheet II-A-1h

Oxyacetylene Fusion Welding Flames


Carburizing Flame
Neutral Flame
Oxidizing Flame

Reprinted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module A: Equipment Set-up and Maintenance

Task 2: CHANGE OXYGEN, ACETYLENE OR MAPP GAS (METHYLACETYLENE PROPADIENE) CYLINDERS

Performance Checklist

1. Turn valve on cylinders off.
2. Bleed regulator.
3. Remove regulators.
4. Replace safety cap on cylinder.
5. Unchain cylinders.
6. Roll to storage area.
7. Roll full cylinder to hook up.
8. Chain full cylinder to cart.
9. Remove safety cap.
10. Crack valve to clean out foreign particles.
11. Close valve and inspect threads.
12. Install regulators.
13. Open valve and check for leaks.

Test

Items Needed:
1. Safety equipment
2. Tools and equipment, as indicated by instructor
3. Oxygen cylinder
4. Acetylene cylinder
5. Propane base type MAPP gas cylinders

Task:
1. Change oxygen cylinder when empty.
2. Change acetylene cylinder when empty.
3. Change MAPP gas (methylacetylene propadiene) cylinder when empty.

Standard:
1. The oxy-fuel equipment must not leak.
2. The oxy-fuel equipment will operate safely.

Learning Activities

1. Read (or review) one (1) of the following:
   - a. Welding Principles and Practices (Sacks), pp. 139-164.
   - b. Welding Technology (Kennedy), pp. 153-223.
2. Read (or review) one (1) of the following:
   - a. Gas Welding (Giachino), pp. 1-21.
   - b. Modern Welding (Althouse/Turnquist/Bowditch), pp. 1-9 to 1-14 and 2-1 to 2-28.
   - c. Welding Skills and Practices (Giachino/Weeks), pp. 238-259.

3. Write (or review) answers to one (1) of the following:

    a. Welding Principles and Practices (Sacks), Review Questions, pp. 163-164.
    b. Welding Technology (Kennedy), Review Questions, pp. 222-223.

4. Observe demonstration by instructor.

5. Review Information Sheets II-A-1 through II-A-1c.

6. Enter new terms and definitions in your notebook.

7. List in Safety Notebook.

    a. Five (5) personal safety practices.
    b. Five (5) general shop area safety practices.

8. In the Procedure Notebook, write the procedure for changing:

    a. Oxygen cylinder
    b. Acetylene cylinder
    c. MAPP gas cylinder

9. Follow all procedures, in order, on the Performance Checklist and practice changing:

    a. Oxygen cylinder
    b. Acetylene cylinder
    c. MAPP gas cylinder

10. Rewrite or correct your written procedure for changing the three (3) types of cylinders (Learning Activity 8).

11. In the presence of your instructor, change the cylinders of the oxy-fuel system. Your instructor will evaluate your work.

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module A: Equipment Set-up and Maintenance

Task 3: CLEAN WELDING AND CUTTING TIPS ON OXY-FUEL EQUIPMENT

Performance Checklist

1. Examine the tip to determine:
   a. Orifice size.
   b. Condition of orifice end of tip.
2. Select tip cleaners.
3. File orifice end.
4. Clean tip, using a tip cleaner two (2) sizes smaller than the tip orifice. Use straight push-pull action to eliminate egg-shaped hole. Gradually increase tip cleaner size to original orifice size.
   a. Where possible, use long tip cleaners and insert through back of tip.
   b. Welding tips and cutting tips that cannot be cleaned from the back must be cleaned through the orifice end.

Test

Items Needed:
1. Safety equipment
2. Oxy-fuel equipment
3. Welding and cutting tips
4. File
5. Tip cleaners
6. Manual indicating tip sizes

Task: Use tip cleaners to clean oxy-fuel cutting and welding tips.

Standard:
1. Finished tip will be filed square.
2. Orifice hole will be round.
3. There must be no foreign particles on the cleaned tips and orifices.

Learning Activities

1. Read one (1) of the following:

   a. Welding Principles and Practices (Sacks), pp. 149-152, 158-161, and 228-240.
   b. Welding Technology (Kennedy), pp. 185-195, 207-208, 212-216, and 271-296.

2. Read one (1) of the following:

    a. Gas Welding (Giachino), pp. 6-8, 16, and 71-73.
    b. Modern Welding (Althouse/Turnquist/Bowditch), pp. 1-9 to 1-10, 1-15 to 1-19, 2-24 to 2-31, 3-1 to 3-7, and 4-1 to 4-12.
    c. Welding Skills and Practices (Giachino/Weeks), pp. 243-246, 254-255, and 336-342.

3. Write the answers to the questions found at the end of chapters of one (1) of the reading assignments.

4. Observe demonstration by instructor.

5. Review Information Sheets II-A-1 through II-A-1c.

6. List new terms and definitions in your notebook.

7. In your Safety Notebook, list:

    a. Five (5) personal safety practices.
    b. Five (5) general shop safety practices.

8. Inspect several tips in need of cleaning. Then discuss the consequences of operating an oxy-fuel system with:

    a. Tips that are not filed square
    b. An orifice hole that is not round
    c. Foreign particles (dirt) on the tips and orifices

9. Practice cleaning and filing welding and cutting tips.

10. While your instructor observes, remove welding and cutting tips and clean with tip cleaner.

11. In the presence of your instructor, perform the cleaning operation, as described in the Performance Checklist.

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module A: Equipment Set-up and Maintenance

Task 4: PERFORM SOAP AND WATER AND/OR SUBMERGED LEAK TEST AND REPAIR GAS WELDING EQUIPMENT

Performance Checklist

1. Close torch valves.
2. Apply normal pressure.
3. Mix neutral soap and water. (Not required for submerged leak test.)
4. Brush soapy water over hoses and valves OR completely submerge hoses and torch unit.
5. Check for bubbles.
6. Mark discovered leaks with tape.
7. Relieve hose pressure.
8. Repair hoses and torch as required.
9. Recheck for leaks.

Test

Items Needed:
1. Safety equipment
2. Gas welding equipment
3. Neutral soap
4. Water
5. Brush
6. Tape

Task:
1. Perform soap and water leak test on gas welding equipment.
2. Perform submerged leak test on gas welding equipment.
3. Use tape to mark all identified leaks.
4. Repair hoses and torch as required.
5. Recheck for leaks.

Standard:
1. All leaks will be marked and repaired.
2. Hoses and torch will not leak after repair and test.

Learning Activities

1. Read the following:
   a. Welding Skills and Practices (Giachino/Weeks), pp. 252-256.
2. Observe demonstration by instructor.

3. In your Procedure Notebook, write:

   a. Procedure for soap test for leaks.
   b. Procedure for submerged test for leaks.

4. Review Information Sheets II-A-1 through II-A-1c

5. In your Safety Notebook, list:

   a. Five (5) safety practices.
   b. Why oil cannot be used for checking for leaks.
   c. Two (2) reasons why leaking systems should not be used.

6. With instructor and classmates, establish a written policy for dealing with leaking fuel and oxygen cylinders, gauges, hoses, and torches.

   a. Write the policy in your Procedure Notebook.

7. Observe demonstration by the instructor on repairing leaks in gas welding equipment.

8. Practice the procedure.

9. In the presence of your instructor:

   a. Perform a soap and water leak test and mark leaks.
   b. Perform a submerged leak test and mark leaks.
   c. Repair hoses and torch, as required.

10. All items on the Module A Instructor Check Sheet must be completed and approved by the instructor.

Unit II-Module A

INSTRUCTOR CHECK SHEET: Place date activity is completed and approved in Approved column. Rate quality of performance 1 to 4 (1 is poor) in Quality column.

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
1. Oral safety quiz - safety practice for oxy-fuel.						
2. Set up portable oxy-fuel equipment.						
3. Set up stationary oxy-fuel equipment.						
4. Changing oxygen tank.						
5. Changing fuel tank: Acetylene						
Mapp						
6. Cleaning tips: Welding						
Cutting						
7. System test: Soap						
Submerged						

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module B: Cutting and Shaping Materials

Task 1: CUT CARBON STEELS WITH OXY-ACETYLENE EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Determine grade of steel using:
   a. Spark stream.
   b. Code number.
3. Measure and mark with soapstone.
4. Select proper torch tip.
5. Check all fittings, hoses, regulators for proper condition.
6. Adjust regulators; light and adjust torch.
7. Cut metal according to instructions on work order.

Test

Items Needed:
1. Work order requiring different thicknesses of carbon steels (of thicknesses from 1/4" (6.3mm) to 1-1/4" (31.5mm)
2. Safety equipment
3. Oxy-acetylene equipment
4. Carbon steels
5. Measuring instrument
6. Soapstone

Task:
1. Use oxy-acetylene equipment to cut carbon steel according to work order specifications.
2. Make the following types of cuts:
   a. Straight
   b. Angle
   c. Slot
   d. Bevel
   e. Circle
   f. Piercing

Standard: Metal cuts must meet a tolerance of ± 3/32" (2.5mm).

Learning Activities

1. Read one (1) of the following:

   a. Welding Principles and Practices (Sacks), pp. 95-107, 227-231, and 469-492.
   b. Welding Technology (Kennedy), pp. 271-296.

2. Read one (1) of the following:
   a. Gas Welding (Giachino), pp. 71-79.
   b. Modern Welding (Althouse/Turnquist/Bowditch), pp. 3-1 to 4-12.
   c. Welding Principles and Practices (Sacks), pp. 28-32 and 336-342.

3. Write answers to the questions of one (1) of the following:
   a. Gas Welding (Giachino), "Self-Quiz," pp. 78-79.
   b. Modern Welding (Althouse/Turnquist/Bowditch), "Test Your Knowledge," pp. 3-21 and 4-12.
   c. Welding Principles and Practices, Student Guide (Sacks), pp. 35 and 67-69.

4. Attend a lecture-demonstration by your instructor on determining grades of steel by:
   a. Spark stream
   b. Using code number

5. Practice the methods demonstrated in Learning Activity 4:
   a. Perform a spark stream test on five (5) carbon steel samples.
   b. Identify five (5) carbon steel samples by using the code number.

6. Attend a lecture by your instructor on preparing carbon steel for cutting.

7. From your instructor, obtain a measurement worksheet. Measure and mark the sheet as indicated. If you have any difficulties in locating the precise measurements on a steel rule, or other measuring instrument, ask your instructor for additional instruction.

8. Practice measuring and making precise markings on a carbon steel work piece.

9. Attend a lecture-demonstration on tip selection and preparation of equipment for cutting.

10. Obtain a work order and interpret the specifications. Select the tip indicated for the order.

11. Attend lecture-demonstrations on making the following cuts:
    a. Straight
    b. Angle
    c. Slot
    d. Bevel
    e. Circle
    f. Piercing

12. In your notebooks, list:
    a. Notes from instructor's demonstrations
    b. Terms and definitions

13. List in your Safety Notebook:
    a. Five (5) personal safety practices.
    b. Five (5) general shop safety practices.
    c. Safety equipment necessary for the task.

14. Obtain five (5) pieces of carbon steel of various thickness - between 1/4" (6.3mm) and 1-1/4" (31.5mm):
    a. Determine carbon content.
    b. Set up cutting torch.
    c. Practice the following cuts:
        (1) Straight
        (2) Angle
        (3) Slot
        (4) Bevel
        (5) Circle
        (6) Piercing

15. See Welding Principles and Practices (Sacks), pp. 486, 488, 489, and 491, for suggested practice sheets and shapes.

16. Practice cutting in the following positions:
    a. Flat or horizontal position
    b. Vertical position

17. Obtain a work order from your instructor:
    a. Obtain material specified.
    b. Make the cuts indicated to tolerance of ± 3/32" (2.5mm).
    c. Have your instructor evaluate your performance.

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module B: Cutting and Shaping Materials

Task 2: FORGE METALS WITH GAS EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Select oxy-fuel equipment.
3. Select hand tools.
4. Select metal.
5. Hand forge metal, using anvil as required.

Test

Items Needed:
1. Work order, with a sketch, requiring forging of a part or fitting
2. Safety equipment
3. Tools, as indicated by work order
4. Metal
5. Oxy-fuel equipment
6. Anvil

Task: Use gas equipment to hand forge metal as required by work order.

Standard: Hand-forged metal will conform to the specifications in the work order.

Learning Activities

1. Read one (1) of the following:
   a. Modern Welding (Althouse/Turnquist/Bowditch), pp. 17-21 and 17-22.
   b. Welding Technology (Kennedy), p. 14.
2. Attend a lecture-demonstration on forging with gas equipment.
3. List in your Safety Notebook:
   a. Five (5) personal safety practices.
   b. Five (5) general shop safety practices.
   c. Safety equipment needed.
4. Watch a demonstration on antiquing metals.

5. From your instructor, obtain a work order form for a forged part. (See sample on Information Sheet II-B-2.)

   a. Obtain material specified.
   b. Set up oxy-fuel system.
   c. Produce part.
   d. Submit your work to the instructor for evaluation.

Information Sheet II-B-2

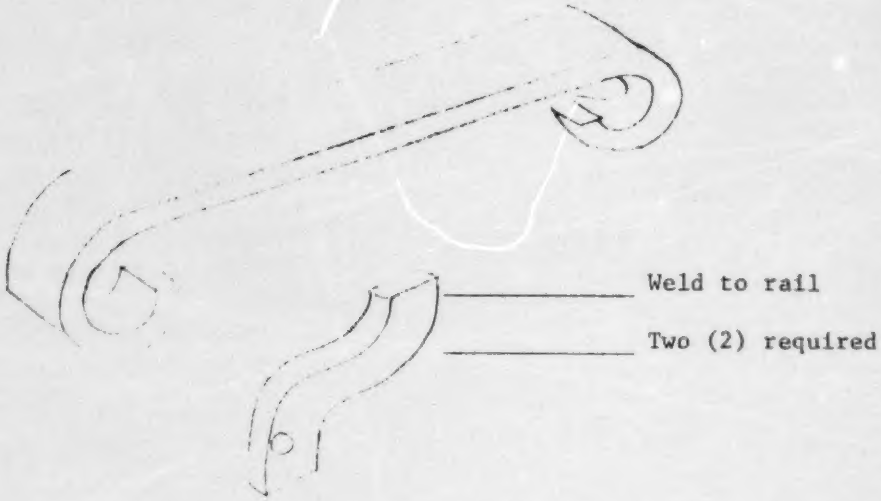
Sample Work Order

HAND RAIL

Stock:

cold rolled steel

1 pc 1/2 x 1 1/2 x desired length
2 pc 1/2 x 1 1/2 x 6"



Shape ends using heat forging.

Form mounting brackets.

Weld mounting brackets to rail.

To Antique: Spot heat face and strike with ball peen hammer.

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module B: Cutting and Shaping Materials

Task 3: SHAPE METALS USING GAS WELDING EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Select oxy-fuel equipment.
3. Select proper hand tools.
4. Select correct method.
5. Shape metal as required.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Oxy-fuel equipment
4. Metal stock
5. Necessary hand tools

Task: Follow work order specifications to heat, shape or bend metal.

Standard: Work must conform to the instructions and specifications in the work order.

Learning Activities

1. Read one (1) of the following:
   - a. Modern Welding (Althouse/Turnquist/Bowditch), pp. 17-21 to 17-22.
   - b. Welding Technology (Kennedy), p. 14.
2. Observe a demonstration by instructor.
3. List in safety notebook:
   - a. Five (5) personal safety practices.
   - b. Five (5) general shop safety practices.
   - c. Safety equipment needed.
4. Practice shaping several kinds of metals, as directed by your instructor.
5. Obtain from instructor a work order form:
   - a. Obtain material specified
   - b. Set up oxy-fuel system
   - c. Produce part
   - d. Submit for evaluation by instructor

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module B: Cutting and Shaping Materials

Task 4: REMOVE DISTORTION USING GAS WELDING EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Determine neutral axis of work piece.
3. Set up and adjust heating flame.
4. Heat work piece to remove distortion.
5. Cool slowly to eliminate stresses.

Test

Items Needed:
1. Safety equipment
2. Gas welding equipment
3. Distorted metal work piece

Task:
1. Analyze distortion.
2. Heat work piece to remove distortion.

Standard:
1. Finished work piece will be free of distortion.
2. Finished workpiece will be serviceable in its intended use.

Learning Activities

1. Read two (2) of the following:
   a. Welding Principles and Practices (Sacks), pp. 108-114.
   b. Welding Technology (Kennedy), pp. 96-111.
   c. Welding Skills and Practices (Giachino/Weeks), pp. 32-40.
2. Observe demonstration by instructor.
3. List in Safety Notebook:
   a. Five (5) personal safety practices
   b. Five (5) general shop safety practices
   c. Safe equipment need
4. Discuss with class ways to prevent distortion.
5. Practice removal of distortion.
6. Obtain, from instructor, a distorted metal work piece.
   a. Remove distortion.
   b. Have your instructor evaluate your work.

7. All items on the Module B Instructor Check Sheet must be completed and approved by the instructor.

Unit II-Module B

INSTRUCTOR CHECK SHEET: Place date activity is completed and approved in Approved column. Rate quality of performance 1 to 4 (1 is poor) in Quality column.

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
1. Cutting carbon steel flat position:						
1/8" to 1/4" thickness						
1/4" to 1/2" thickness						
1/2" to 3/4" thickness						
Other - (Specify)						
2. Cutting carbon steel vertical position:						
1/8" to 1/4" thickness						
1/4" to 1/2" thickness						
1/2" to 3/4" thickness						
Other - (Specify)						
3. Cutting pipe. Diameter:						
4. Forge metal with oxy-fuel. Type:						
5. Shaping metal:						
6. Removal of distortion:						

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module C: Brazing and Soldering

Task 1: BRAZE FERROUS AND NON FERROUS METALS WITH GAS EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Clean and prepare joints.
3. Select correct tip, filler rod, and flux.
4. Turn on and adjust flame.
5. Tack parts.
6. Check alignment.
7. Braze parts after preheating.
8. Clean and cool work piece.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Oxyacetylene equipment
4. Necessary tools
5. Ferrous or non-ferrous metal project

Task: Braze ferrous or non-ferrous metal joints.

Standard:
1. Brazed joints must have even beads and proper bond.
2. Puddles must be smooth and even.
3. There will be no holes, craters, or undercut.

Learning Activities

1. Read one (1) of the following:
   a. _Welding Principles and Practices_ (Sacks), pp. 543-544 and 552-567.
   b. _Welding Technology_ (Kennedy), pp. 25, 29, and 589-594.

2. Read one (1) of the following:
   a. _Gas Welding_ (Giachino), pp. 43-48.
   b. _Modern Welding_ (Althouse/Turnquist/Bowditch), pp. 16-1 to 16-8.
   c. _Welding Skills and Practices_ (Giachino/Weeks), pp. 297-305.

3. Observe demonstration by instructor of:
    - a. Brazing ferrous metals
    - b. Brazing non-ferrous metals
    - c. Preparing metals for brazing

4. In Terms and Definitions Notebook, define the following:
    - a. Ferrous metals
    - b. Non-ferrous metals
    - c. Brazing
    - d. Braze welding
    - e. List seven (7) braze filler materials and their application.

5. In Safety Notebook list:
    - a. Five (5) personal safety practices
    - b. Five (5) general shop safety practices
    - c. Safety equipment needed

6. Discuss (with class or instructor) visual examination of braze:
    - a. Good braze
    - b. Poor braze
    - c. Puddle formation
    - d. Coloration

7. Obtain work order for ferrous metal from instructor:
    - a. Obtain material specified.
    - b. Set up oxy fuel system.
    - c. Braze in indicated position:
        - (1) Flat
        - (2) Horizontal
        - (3) Vertical
        - (4) Overhead
    - d. Submit project to your instructor for evaluation.

8. Obtain work order for non-ferrous metal from instructor:
    - a. Obtain material specified.
    - b. Set up oxy fuel system.
    - c. Braze in indicated position.
    - d. Submit project to instructor for evaluation.

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module C: Brazing and Soldering

Task 2: SILVER BRAZE FERROUS AND NON FERROUS METALS WITH GAS EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Clean and flux the joint.
3. Select correct size welding tip.
4. Turn on gas and adjust flame.
5. Heat metal, flux and apply brazing alloy.
6. Cool, clean, and check joint for holes and smoothness.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Gas welding equipment
4. Ferrous metal
5. Non-ferrous metal
6. Flux
7. Silver brazing alloy

Task: Silver braze ferrous metal with gas equipment according to work order specifications.

Standard: Visual inspection will show:
- a. Complete joint penetration.
- b. 100% coverage of joint surfaces.
- c. Complete adherence to base metal.

Learning Activities

1. Read one (1) of the following:
   - a. Welding Principles and Practices (Sacks), pp. 555-567.
   - b. Welding Technology (Kennedy), p. 28.
2. See one (1) of the following:
   - a. Gas Welding (Giachino), pp. 43-48.
   - b. Modern Welding (Althouse/Turnquist/Bowditch), pp. 16-10 to 16-13.
   - c. Welding Skills and Practices (Giachino/Weeks), p. 306.

3. Observe demonstration by instructor of how to:

    a. Silver braze ferrous metal
    b. Silver braze non ferrous metal

4. In Safety Notebook list:

    a. Five (5) personal safety practices
    b. Five (5) general shop safety practices
    c. Safety equipment needed

5. Select ferrous and non ferrous items to silver braze. Then:

    a. Set up oxy fuel system
    b. Silver braze
    c. Submit completed items to your instructor for evaluation.

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module C: Brazing and Soldering Operations

Task 3: LEAD SOLDER FERROUS AND NON-FERROUS METALS WITH GAS EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Select correct flux for metal used.
3. Clean and flux joint.
4. Select correct welding tip size.
5. Heat metal surface and apply solder.
6. Cool and check joints for holes and capillary action.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Gas welding equipment
4. Lead solder
5. Fluxes
6. Necessary material and tools

Task: Follow the work order specifications and lead solder ferrous and non-ferrous joints.

Standards:
1. The joints will be smooth and continuous.
2. The joints will be completely sealed.

Learning Activities

1. Read one (1) of the following:
   - a. Welding Principles and Practices (Sacks), pp. 544-552.
   - b. Welding Technology (Kennedy), pp. 25-28.
2. See one (1) of the following:
   - a. Gas Welding (Giachino), pp. 48-52.
   - b. Modern Welding (Althouse/Turnquist/Bowditch), pp. 15-1 to 15-14.
   - c. Welding Skills and Practices (Giachino/Weeks), pp. 305-311.
3. Observe demonstration by instructor of:
   - a. Lead soldering ferrous metals with gas equipment
   - b. Lead soldering non ferrous metals with gas equipment

4. Discuss and examine samples of:

    a. Good quality lead-soldering. List "acceptable" criteria.
    b. Poor quality lead-soldering. List "unacceptable" criteria.

5. In Safety Notebook, list:

    a. Five (5) personal safety practices.
    b. Five (5) general shop safety practices.
    c. Safety equipment needed.

6. Following Information Sheet II-C-3 (Sample Work Order: Lead Soldering Ferrous Metal), practice lead soldering ferrous metals.

7. Obtain work order for lead soldering ferrous metal with oxy fuel system:

    a. Obtain material specified.
    b. Set up oxy fuel system.
    c. Solder samples.
    d. Submit to instructor for evaluation.
    e. Cut apart to examine quality.

8. Obtain work order for lead soldering non ferrous metal with oxy fuel system:

    a. Obtain material specified.
    b. Set up oxy fuel system.
    c. Solder samples.
    d. Submit to instructor for evaluation.
    e. Cut apart to examine quality of solder.

9. All items on the Module C Instructor Check Sheet must be completed and approved by the instructor.

Information Sheet II-C-3

Sample Work Order

LEAD SOLDERING FERROUS METAL

I. Obtain six (6) pieces, 3" x 6", of the following:

   a. Tin plate
   b. Galvanized sheet
   c. Steel sheet

II. Lay out for 1/2" lap joint

III. Using appropriate flux and solder, solder two (2) samples of each material with oxy fuel system in each of the following positions:

   a. Flat or horizontal
   b. Vertical
   c. Overhead

IV. Submit samples to instructor for evaluation.

Unit II-Module C

INSTRUCTOR CHECK SHEET: Place date activity is completed and approved in Approved column. Rate quality of performance 1 to 4 (1 is poor) in Quality column.

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
1. Solder ferrous metal:						
Tin plate						
Galvanized						
Mild steel						
2. Solder non-ferrous:						
Copper to copper -						
Horizontal position						
Vertical position						
Inverted position						
Other - (Specify)						
Aluminum to aluminum -						
Horizontal position						
Vertical position						
Inverted (overhead)						
Other - (Specify)						
3. Braze ferrous metals:						
Mild steel -						
Flat position						
Horizontal position						
Vertical position						
Inverted (overhead)						
Other - (Specify)						
4. Braze non-ferrous metals:						
Aluminum -						
Flat position						
Horizontal position						
Vertical position						
Inverted (overhead)						
Other - (Specify)						

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
5. Silver braze ferrous metal:						
Mild steel -						
Flat position						
Horizontal position						
Vertical position						
Inverted (overhead)						
Other - (Specify)						
6. Silver braze non-ferrous:						
Copper pipe -						
Horizontal position						
Vertical position						
Inverted (overhead)						

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module D: Welding and Braze Welding

Task 1: GAS WELD CARBON STEELS

Performance Checklist

1. Select safety equipment.
2. Clean and prepare joints.
3. Select tip and filler rod.
4. Weld joints.
5. Clean and check welds.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Carbon steel
4. Oxy-acetylene welding equipment
5. Necessary tools

Task: Gas weld carbon steel joint(s).

Standards
1. Weldment must have smooth even beads.
2. Weldment must have penetration of parent metal and complete fusion.
3. Beads must be smooth and even.
4. There will be no holes, craters, or undercrust.

Learning Activities

1. Read two (2) of the following:
    a. Welding Principles and Practices (Sacks), pp. 493-524.
    b. Welding Procedures Oxy-acetylene (Schell), pp. 17-30, 32-42, and 45-52.
    c. Welding Skills and Practices (Giachino/Weeks), pp. 252-277.
    d. Welding Technology (Kennedy), pp. 224-251.
2. In a class discussion, distinguish between braze welding and gas welding.
3. List in Safety Notebook:
    a. Safety equipment needed
    b. Five (5) personal safety practices

4. Observe a demonstration by instructor on:
    a. Preparing carbon steels for welding.
    b. Gas welding carbon steel.

5. Practice welding carbon steel.

6. Obtain work order from instructor:
    a. Select safety equipment needed.
    b. Obtain metal specified and prep for welding.
    c. Set up oxy-fuel system; select tip and filler rod.
    d. Perform weld according to specs in work order.
    e. Submit finished project to instructor for evaluation.

7. As directed by your instructor, repeat Learning Activity 6, changing:
    a. Thickness of metal.
    b. Weld position.

3. Observe demonstration by instructor:

    a. Preparing cast iron for welding.
    b. Welding cast iron with oxy-fuel system.

4. Practice welding cast iron with oxy-fuel system.

5. Obtain work order from instructor:

    a. Select safety equipment.
    b. Obtain cast iron project specs in work order.
    c. Prep material for welding.
    d. Set up equipment; select tip, flux, and filler rod.
    e. Perform weld.
    f. Submit to instructor for evaluation.

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module D: Welding and Braze Welding

Task 3: GAS WELD COPPER OR COPPER ALLOYS

Performance Checklist

1. Select safety equipment.
2. Clean joint (flux, if alloy).
3. Select tip and filler rod.
4. Heat work piece as required
5. Weld joint.
6. Cool and check joint.
7. Mechanically work joint (peening) to strengthen it.

Test

Items Needed:
1. Work Order
2. Safety equipment
3. Copper or copper alloy metals
4. Gas equipment and tools
5. Flux

Task:
1. Select method and correct flux as required.
2. Gas weld copper or copper alloy joints.

Standard:
1. Weldment must have even weld beads.
2. Weldment must have penetration of parent metal and complete fusion.
3. Puddles must be smooth and even.
4. There must be no holes, craters, or undercrust.

Learning Activities

1. Read both of the following:
   - a. Welding Principles and Practices (Sacks), pp. 536.
   - b. Welding Technology (Kennedy), pp. 261-262.
2. List in Safety Notebook:
   - a. Safety equipment needed.
   - b. Five (5) safety practices.
3. Observe demonstration by instructor:
   - a. Preparing copper for gas welding.
   - b. Gas welding copper.

4. Practice welding copper and copper alloys.

5. Obtain work order from instructor:

    a. Select safety equipment.
    b. Obtain metal and prep for welding.
    c. Set up oxy-fuel system; select tip, flux, and filler rod.
    d. Weld copper.
    e. Submit finished project to instructor for evaluation.

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Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module D: Welding and Braze Welding

Task 4: BRAZE WELD CARBON STEEL

Performance Checklist

1. Select safety equipment.
2. Clean joint mechanically by filing or grinding.
3. Vee edge as necessary.
4. Select flux.
5. Select diameter rod to be used.
6. Preheat.
7. Braze weld.
8. Cool slowly.

Test

Items needed:

1. Safety equipment
2. Necessary oxy-acetylene welding equipment
3. Low carbon steel coupons
4. Files
5. Flux
6. Brazing rod

Task:

1. Set up gas brazing equipment.
2. Prepare and braze weld carbon steel.

Standards:

1. Your instructor will inspect your work
2. Visual inspection must show braze metal flowed and adhered making a sealed joint.

Learning Activities

1. Read two (2) of the following:
    - a. Welding Principles and Practices (Sacks), pp. 525-527.
    - b. Welding Procedures--Oxy-acetylene (Schell), pp. 55-59.
    - c. Welding Skills and Practices (Giachino/Weeks), pp. 303-305.
    - d. Welding Technology (Kennedy), pp. 587-589.
2. List in Safety Notebook:
    - a. Safety equipment needed.
    - b. Five (5) safety practices.

3. Observe demonstration by instructor:
    a. Preparing carbon steel for braze welding.
    b. Braze welding carbon steel.

4. Practice braze welding low carbon steel.

5. From your instructor, obtain work order for braze welding steel:
    a. Select safety equipment.
    b. Obtain material specified in work order and prepare for braze welding.
    c. Set up oxy-fuel system; select tip, flux, and pressure setting.
    d. Perform braze weld.
    e. Submit finished project to instructor for evaluation.

6. As directed by your instructor, repeat Learning Activity 6, changing:
    a. Thickness of metal.
    b. Weld position.

Student Competency Sheet

Unit II: OPERATING GAS WELDING EQUIPMENT

Module D: Welding and Braze Welding

Task 5: BRAZE REPAIR CAST IRON CASTINGS

Performance Checklist

1. Select safety equipment.
2. Remove casting skin as necessary.
3. Clean casting mechanically or chemically.
4. Vee the edge as necessary.
5. Drill 1/8" hole beyond each end of crack as necessary.
6. Reinforce with studs as necessary.
7. Select rods and flux.
8. Preheat, if possible.
9. Braze and cool slowly.

Test

Items Needed:
1. Safety equipment
2. Necessary oxy-acetylene welding equipment
3. Broken or cracked casting
4. Electric drill
5. Studs
6. Flux

Task: Prepare, set up and braze broken or cracked casting to serviceable condition.

Standard: An operational check by your instructor will show that the repaired casting conforms to its original serviceability.

Learning Activities

1. Read two (2) of the following:
   - a. Welding Principles and Practices (Sacks), pp. 525-527.
   - b. Welding Procedures--Oxy-acetylene (Schell), pp. 60-62.
   - c. Welding Technology (Kennedy), pp. 587-598.
2. List in Safety Notebook:
   - a. Safety equipment needed.
   - b. Five (5) safety practices.

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3. Observe demonstration by instructor:

    a. Preparing cast iron for braze welding.
    b. Braze welding cast iron.

4. Practice braze welding cast iron.

5. Obtain work order for braze welding cast iron from instructor:

    a. Select safety equipment.
    b. Obtain item specified in work order.
    c. Prepare item for braze welding.
    d. Set up oxy-fuel system; select tip, flux, and pressure setting.
    e. Braze weld cast iron in position indicated.
    f. Submit finished project to instructor for evaluation.

6. Repeat Learning Activity 5, changing position as directed by your instructor.

7. Discuss causes of the following errors:

    a. Improper cut
    b. Excessive slag, rough edge, kerf too wide
    c. Porosity, poor adhesion
    d. Uneven expansion and contraction
    e. Poor weld quality
    f. Poor fusion

8. Inspect gas-welded simple work pieces:

    a. Identify metal.
    b. Identify errors or flaws, if any.
    c. Discuss causes and corrections.

9. All items on the Module D Instructor Check Sheet must be completed and approved by the instructor.

Unit II-Module D

INSTRUCTOR CHECK SHEET: Place date activity is completed and approved in Approved column. Rate quality of performance 1 to 4 (1 is poor) in Quality column.

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
1. Braze weld:						
Mild steel -						
Flat position						
Horizontal position						
Vertical position						
Cast iron -						
Flat position						
Horizontal position						
Vertical position						
2. Gas weld carbon steel:						
Flat position _____ thickness						
Horizontal position						
Vertical position						
Overhead position						
3. Gas weld cast iron:						
Flat position						
Horizontal position						
Vertical position						
Overhead position						
4. Gas weld copper:						
Flat position						
Horizontal position						
Vertical position						
Overhead position						

UNIT III

OPERATING METALLIC AND TUNGSTEN INERT GAS WELDING EQUIPMENT (TIG, MIG)

Terminal Objectives

Upon completion of the modules in this unit, you will:

- Disassemble and clean a GMAW (MIG) torch assembly
- Disassemble and clean a GTAW (TIG) torch assembly
- Weld carbon steels with GMAW (MIG) equipment
- Weld stainless steel alloys with GMAW (MIG) equipment
- Weld aluminum or aluminum alloys with GMAW (MIG) equipment
- Weld carbon steels with GTAW (TIG) equipment
- Weld aluminum or aluminum alloys with GTAW (TIG) equipment
- Weld heat and corrosion resistant (stainless) steels with GTAW (TIG) equipment
- Weld copper or copper alloys with GTAW (TIG) equipment
- Weld chrome-moly steel with GTAW (TIG) equipment
- Weld magnesium alloys with GTAW (TIG) equipment

Student Competency Sheet

Unit III: OPERATING METALLIC AND TUNGSTEN INERT GAS WELDING EQUIPMENT (TIG), (MIG)

Module A: Equipment Maintenance

Task 1: DISASSEMBLE AND CLEAN A GMAW (MIG) TORCH ASSEMBLY

Performance Checklist

1. Check and make sure that electrical power, water and shielding gas are shut off.
2. Obtain necessary safety equipment.
3. Obtain necessary tools.
4. Remove filler wire from GMAW (MIG) torch and cable assembly.
5. Remove torch and cable assembly from GMAW (MIG) power source, wire feeder, water source, and gas source.
6. Disassemble GMAW (MIG) torch.
7. Clean and inspect component parts.
8. Replace defective parts.
9. Reassemble GMAW (MIG) torch assembly less contact tip and nozzle.
10. Connect gun and cable assembly to power source, wire feed, water source, and gas source.
11. Feed wire through torch and cable assembly and install contact tip and nozzle.
12. Test reassembled torch for leaks and correct operation.

Test

Items Needed:
1. Work order with exploded view
2. Safety equipment
3. GMAW (MIG) unit
4. Necessary tools and equipment

Task:
1. Remove and disassemble a GMAW (MIG) torch assembly.
2. Reassemble and replace a GMAW (MIG) torch assembly.

Standards:
1. Torch assembly must be removed, disassembled, reassembled, and replaced in accordance with the work order.
2. The removal, disassembly, assembly, and replacement of the torch assembly must be performed in the sequence listed in the work order.

Learning Activities

1. Read two (2) of the following:

   a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 1.1-8, 4.1-17 through 4.1-20, 5.4-1 through 5.4-4.
   b. Welding Principles and Practices (Sacks), pp. 289-329, 830-836, 851-860.
   c. Welding Procedures MIG & TIG (Schell/Matlock), pp. 1-24.
   d. Welding Skills and Practices (Giachino/Weeks), pp. 194-211.
   e. Welding Technology (Kennedy), pp. 505-514.

2. List in Terms and Definitions Notebook:

   a. Four (4) trade names used.
   b. Four (4) types of gas used.
   c. Types of wire available.
   d. Three (3) types of transfers.

3. Read Information Sheet III-A-1 (Terms for MIG and TIG Welding).

   a. Discuss these terms and enter them, and their definitions, in your notebook as they are introduced by your instructor, in your readings, and/or in your practice assignments.
   b. Point out and discuss the terms as they apply to samples in your classroom.

4. List in Safety Notebook:

   a. Five (5) personal safety practices.
   b. Five (5) general shop safety practices.
   c. Five (5) safety guidelines for handling gases used with MIG equipment.

5. Study Information Sheet III-A-1a (GMAW Equipment).

6. Observe demonstrations by your instructor:

   a. Setting up equipment.
   b. Cleaning torch.
   c. Adjusting gas flow.

7. With instructor observing, disassemble and clean a GMAW (MIG) torch assembly. (See Performance Checklist for procedure.) Your instructor will evaluate your work.

Information Sheet III-A-1

Terms for MIG and TIG Welding

Terms for TIG

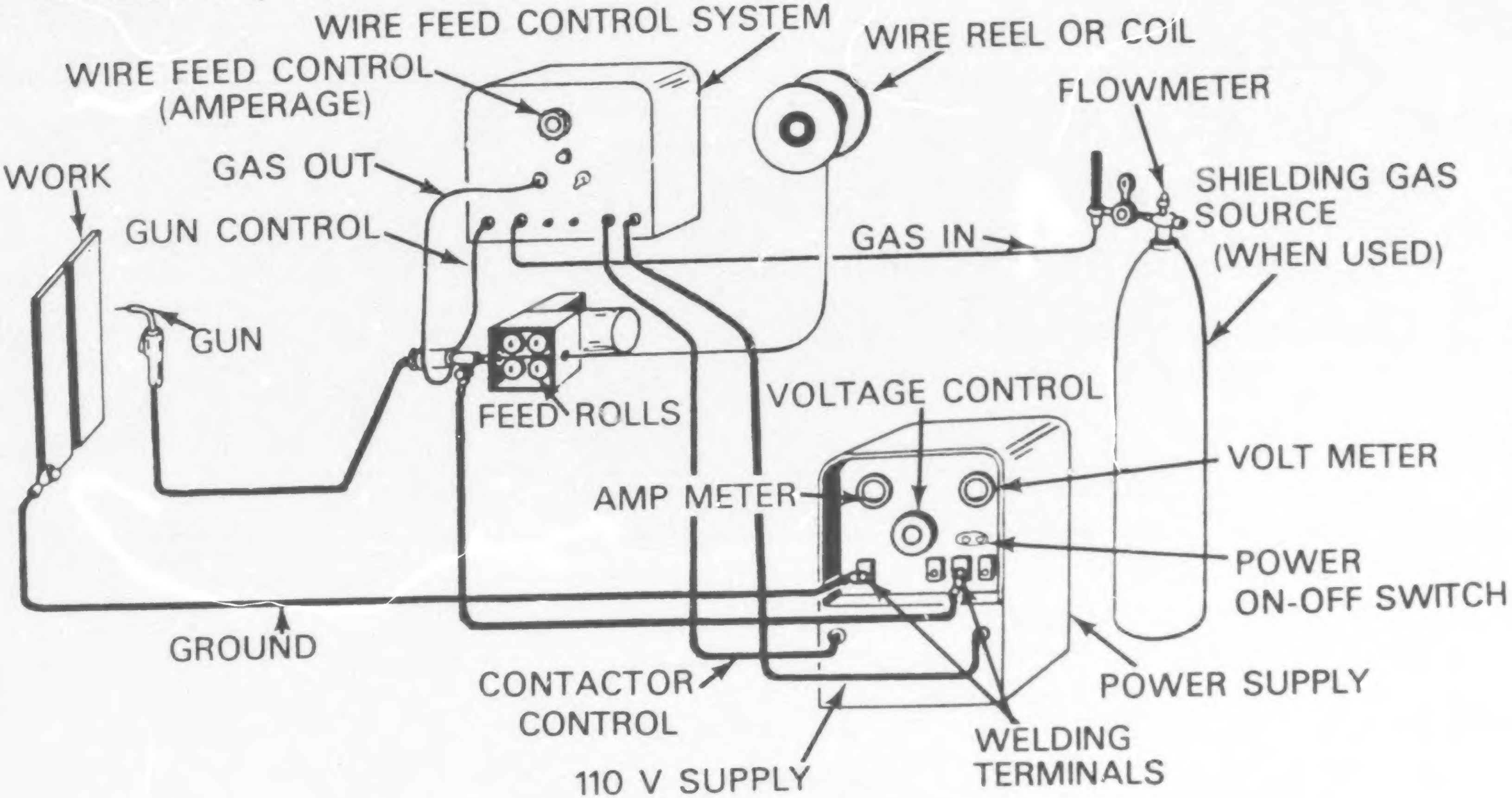
1. Gas tungsten arc welding
2. Inert shielding gas
3. Tungsten electrode
4. High frequency current
5. Flow meter
6. Collet
7. Collet body
8. Foot control
9. Gas cup
10. Porosity
11. Thermal conductivity
12. Metallurgy
13. Aluminum oxide
14. Filler metal
15. Argon
16. Helium
17. Back-up bar
18. Gas nozzle
19. Alloy

Terms for MIG

1. Gas metal arc welding
2. FCAW
3. Short circuiting transfer (short arc)
4. Spray transfer (spray arc)
5. Welding current
6. Welding voltage
7. Slope
8. Slope control
9. Inductance
10. Stick out
11. Whiskers
12. Open circuit voltage
13. Arc voltage
14. Ferrous
15. Non-ferrous
16. Shielding gas

Reprinted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

GMAW Equipment


WIRE FEED CONTROL SYSTEM
WIRE REEL OR COIL
WIRE FEED CONTROL (AMPERAGE)
FLOWMETER
WORK
GAS OUT
SHIELDING GAS SOURCE (WHEN USED)
GUN CONTROL
GAS IN
GUN
FEED ROLLS
VOLTAGE CONTROL
VOLT METER
AMP METER
POWER ON-OFF SWITCH
GROUND
CONTACTOR CONTROL
POWER SUPPLY
WELDING TERMINALS
110 V SUPPLY

*DCRP- MOST GTAW APPLICATIONS
(NOTE: SOME FLUXCORED GTAW IS DONE WITH DCSP)

Student Competency Sheet

Unit III: OPERATING METALLIC AND TUNGSTEN INERT GAS WELDING EQUIPMENT (TIG), (MIG)

Module A: Equipment Maintenance

Task 2: DISASSEMBLE AND CLEAN GTAW (TIG) TORCH ASSEMBLY

Performance Checklist

1. Check and make sure that electrical power, water, and shielding gas are shut off.
2. Obtain necessary tools.
3. Remove torch assembly from GTAW (TIG) power source, water source, and gas source.
4. Disassemble torch.
5. Inspect component parts.
6. Replace defective parts.
7. Reassemble torch assembly.
8. Connect torch assembly to power source, water source, and gas source.
9. Test reassembled torch for leaks and correct operation.

Test

Items Needed:
1. Work order with exploded view.
2. Safety equipment
3. GWAW (TIG) unit
4. Necessary tools and accessories

Task:
1. Remove and disassemble a GTAW (TIG) torch assembly.
2. Reassemble and replace a GTAW (TIG) torch assembly.

Standard:
1. Torch assembly must be removed, disassembled, reassembled, and replaced in accordance with the work order.
2. The removal, disassembly, assembly, and replacement of the torch assembly must be performed in the sequence listed in the work order.

Learning Activities

1. Read two (2) of the following:

   a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 1.1-7 through 1.1-9, 4.1-11 through 4.1-20, 5.4-4 through 5.4-5, and 9.4-5 through 9.4-11.
   b. Welding Principles and Practices (Sacks), pp. 254-275.

   c. Welding Procedures MIG & TIG (Schell/Matlock), pp. 180-200.
   d. Welding Skills and Practices (Giachino/Weeks), pp. 161-182.
   e. Welding Technology (Kennedy), pp. 421-441.

2. Review Information Sheet III-A-1 (Terms).

3. List in Terms and Definitions Notebook:

   a. List two (2) trade names for TIG welding.
   b. List two (2) types of gas used.
   c. List type of electrodes used.
   d. List component parts of torch.

4. List in Safety Notebook:

   a. Five (5) personal safety practices.
   b. Five (5) general shop safety practices.
   c. Three (3) safety guidelines for handling gas.
   d. Safety equipment needed.

5. Study:

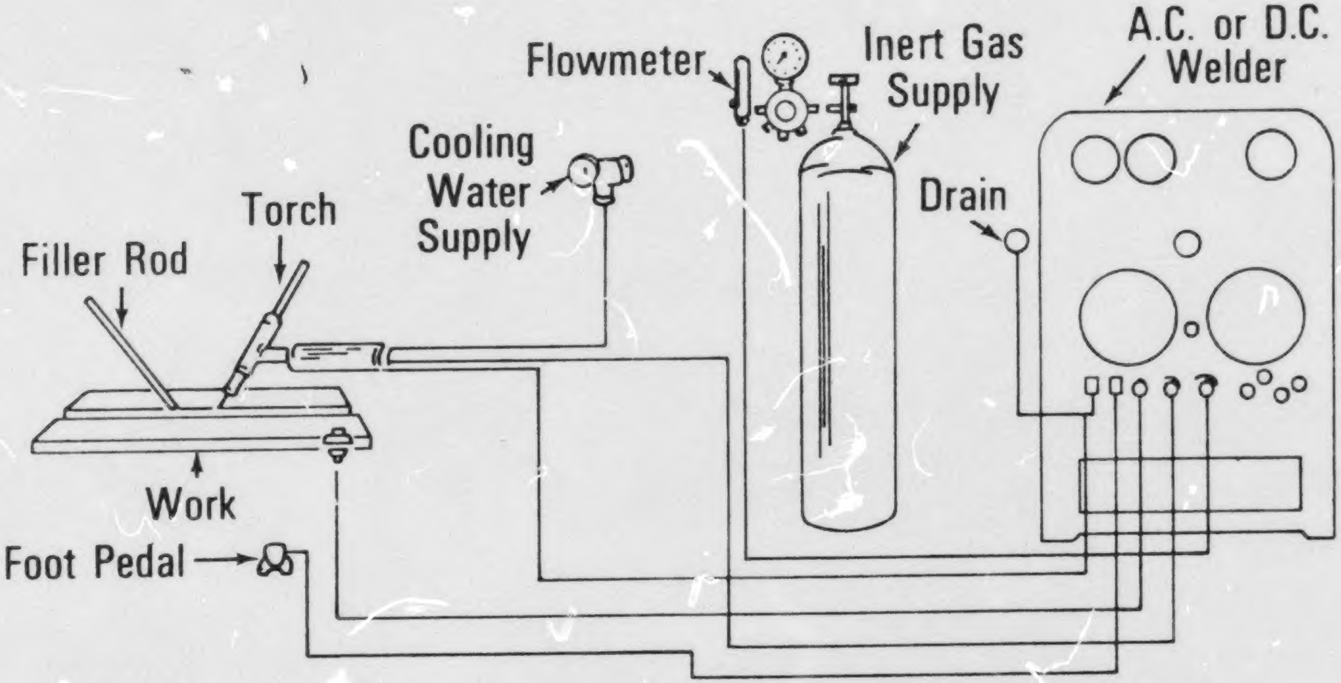
   a. Information Sheet III-A-2 (GTAW Equipment).
   b. Information Sheet III-A-2a (GTAW Torch).

6. Observe demonstrations by instructor:

   a. Cleaning torch--assembly and disassembly.
   b. Setting up TIG equipment.
   c. Adjusting power source, water supply, and gas supply.

7. With instructor observing, disassemble and clean GTAW (TIG) torch assembly. (See Performance Checklist for procedure.) Your instructor will evaluate your work.

GTAW Equipment


Flowmeter
Inert Gas Supply
A.C. or D.C. Welder
Cooling Water Supply
Torch
Drain
Filler Rod
Work
Foot Pedal

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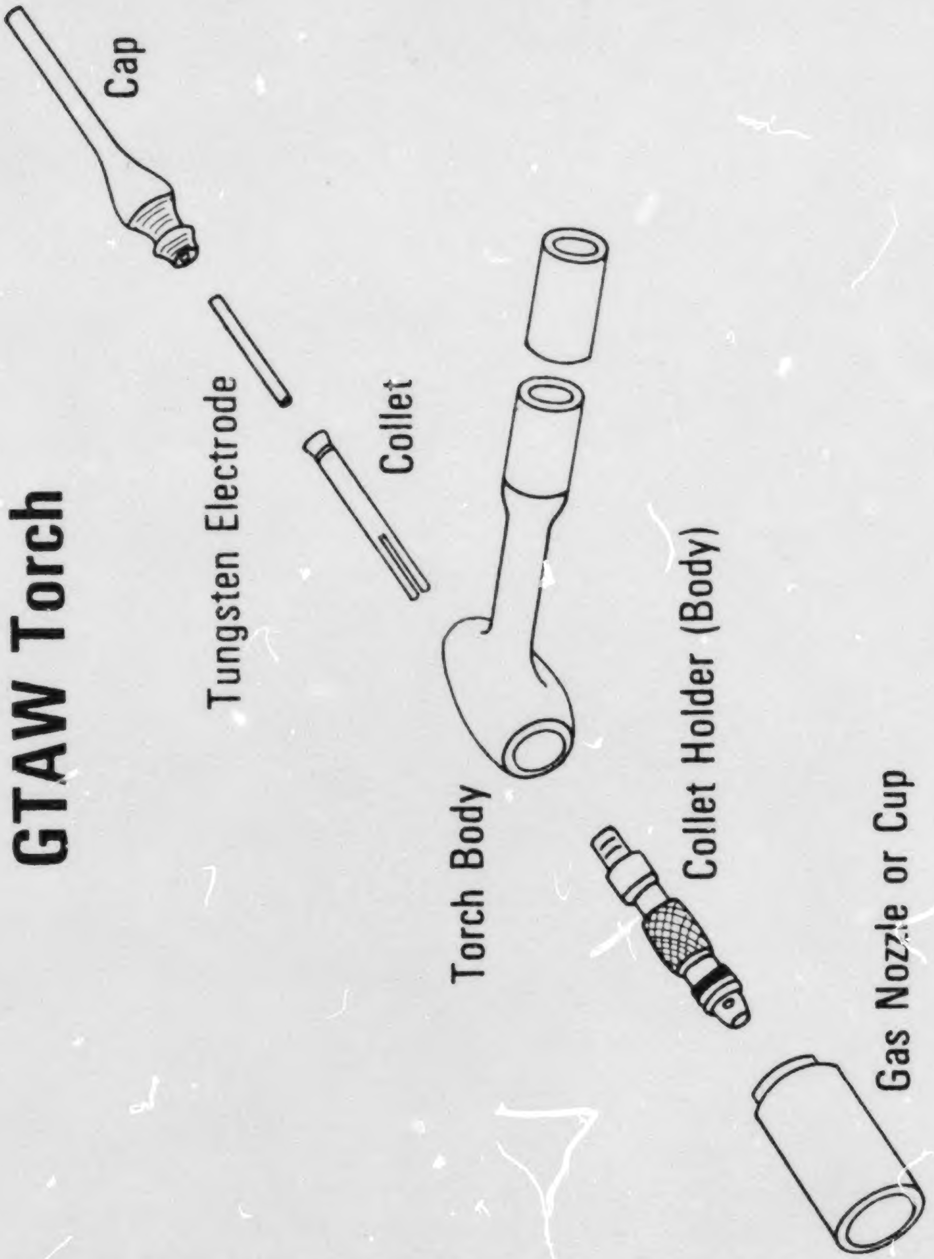
Information Sheet III-A-2a



GTAW Torch

Cap
Tungsten Electrode
Collet
Torch Body
Collet Holder (Body)
Gas Nozzle or Cup

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Student Competency Sheet

Unit III: OPERATING METALLIC AND TUNGSTEN INERT GAS WELDING EQUIPMENT (TIG), (MIG)

Module B: Welding with MIG Equipment

Task 1: WELD CARBON STEELS WITH GMAW (MIG) EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Set up the equipment.
3. Position all cables and hoses so as not to be burned or damaged.
4. Turn on electrical equipment.
5. Turn on and check water flow, as required.
6. Turn on and adjust the shielding gas.
7. Adjust wire feed, voltage, amperage, and stick out.
8. Weld joints using fillet and groove welds in all positions according to work order specifications.

Test

Items Needed:
1. Work order specifying dimensions, type of current, type of gas, and joint design
2. Safety equipment
3. GMAW (MIG) unit
4. Filler wire
5. Carbon steel

Task:
1. Weld carbon steel joints using fillet and groove weld in all positions.
2. Weld carbon steel to work order specifications using a GMAW (MIG) unit.

Standard: Visual inspection of joints will show:
   - a. Smooth and continuous welds.
   - b. Complete penetration.
   - c. Fusion between weld bead and base metal.
   - d. No cracks, undercutting, or overlap.

Learning Activities

1. Read two (2) of the following:
   - a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 6.6-1 through 6.6-4.
   - b. Welding Principles and Parctices (Sacks), pp. 836-841 and 889-903.
   - c. Welding Procedures MIG & TIG (Schell/Matlock), pp. 25-113.

   d. Welding Skills and Practices (Giachino/Weeks), pp. 208-222.
   e. Welding Technology (Kennedy), pp. 514-519.

2. List in Safety Notebook:

   a. Five (5) personal safety practices.
   b. Five (5) general shop safety practices.
   c. Safety equipment needed.

3. Study and discuss:

   a. Information Sheet III-B-1 (GMAW Process).
   b. Information Sheet III-B-1a (GMAW Electric Wire Stick Out).
   c. Information Sheet III-B-1b (Arc Length Arc Volt-Amp Characteristics).

4. Observe a demonstration by instructor:

   a. Preparing metal for welding.
   b. MIG welding butt joint in low carbon steel in flat position.

5. Practice MIG welding carbon steel.

6. Obtain work order from instructor.

   a. Obtain material--metal, safety equipment; prepare metal.
   b. Set up MIG equipment.
   c. Perform weld to specs.
   d. Submit project to instructor for evaluation.

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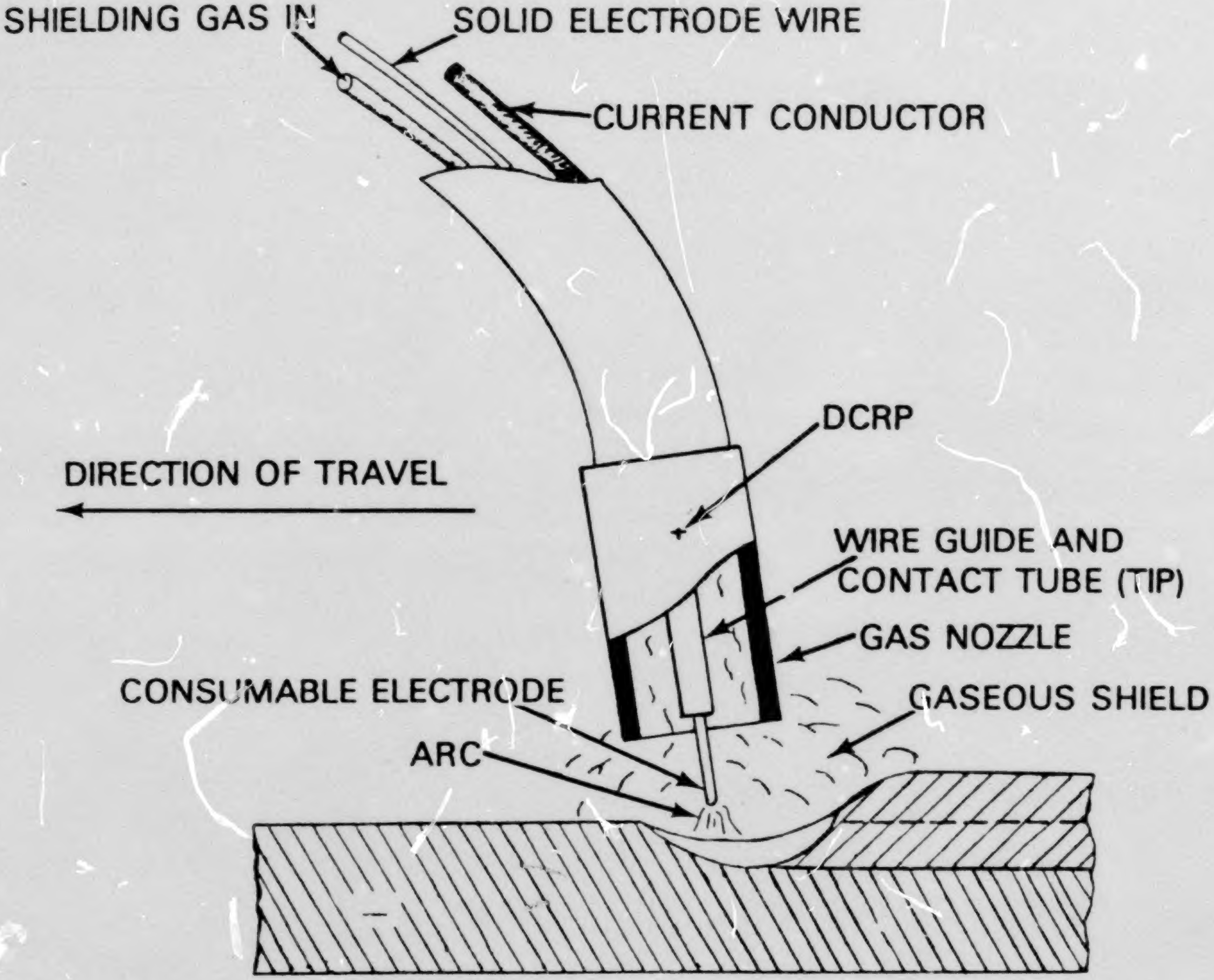
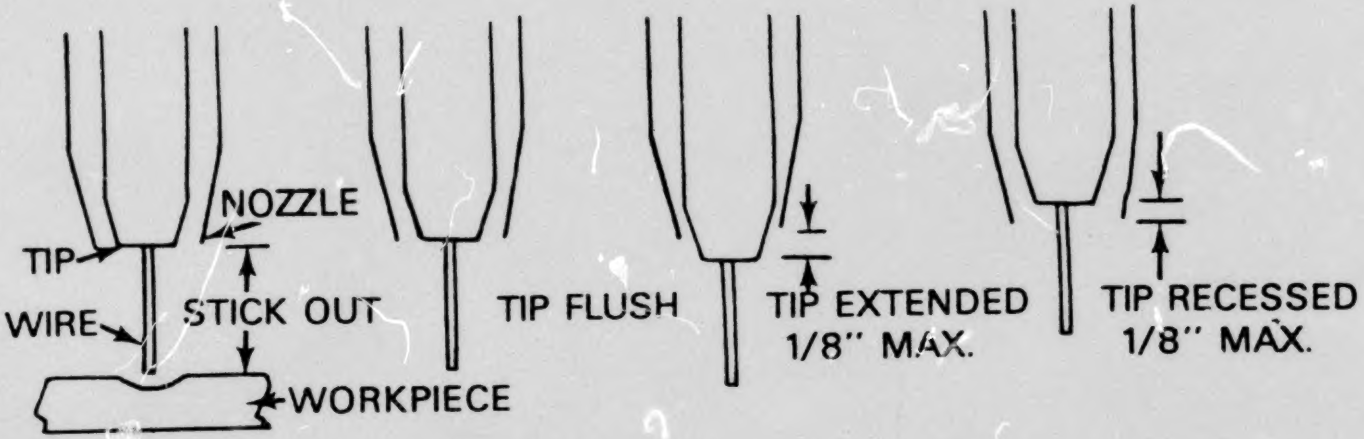
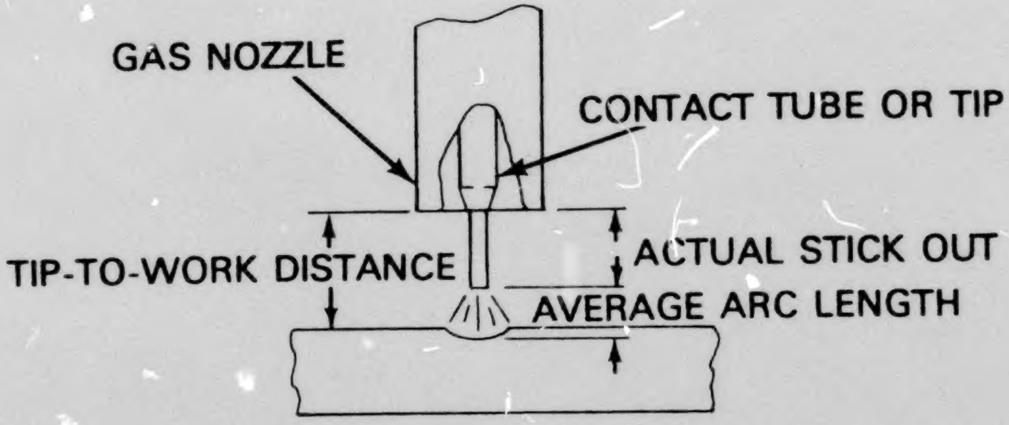
GMAW Process


SHIELDING GAS IN
SOLID ELECTRODE WIRE
CURRENT CONDUCTOR
DCRP
DIRECTION OF TRAVEL
WIRE GUIDE AND CONTACT TUBE (TIP)
GAS NOZZLE
CONSUMABLE ELECTRODE
GASEOUS SHIELD
ARC

GMAW Electric Wire Stick Out


NOZZLE
TIP
WIRE
STICK OUT
WORKPIECE
TIP FLUSH
TIP EXTENDED
1/8" MAX.
TIP RECESSED
1/8" MAX.


GAS NOZZLE
CONTACT TUBE OR TIP
TIP-TO-WORK DISTANCE
ACTUAL STICK OUT
AVERAGE ARC LENGTH

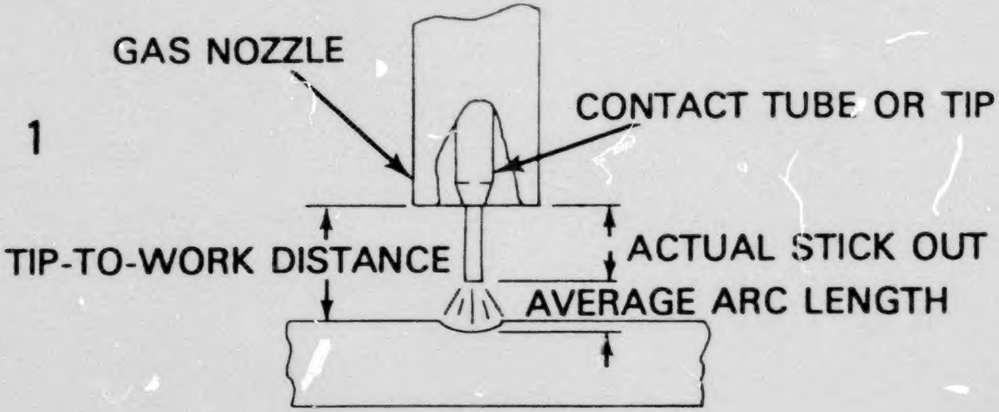
(STICK OUT IS TIP-TO-WORK)

Reprinted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

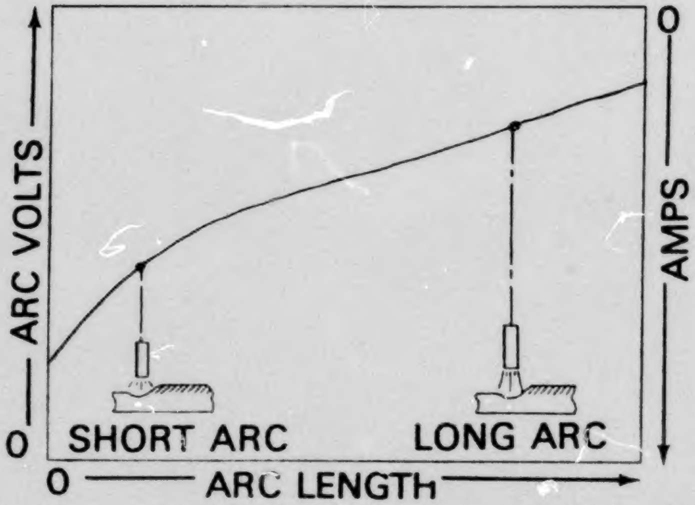
Arc Length Arc Volt-Amp Characteristics

Reprinted from: Oklahoma State Department of Vocational and Technical Education, Vocational Trade and Industrial Education--Welding, Stillwater, OK: Curriculum and Instructional Materials Center, 1974.

1


GAS NOZZLE
CONTACT TUBE OR TIP
TIP-TO-WORK DISTANCE
ACTUAL STICK OUT
AVERAGE ARC LENGTH

2



1 SMALL CHANGE IN ARC VOLTS (ARC LENGTH CHANGED BY WELDER'S MOVEMENT OF GUN) RESULTS IN LARGE CHANGE OF WELDING CURRENT (AMPS)

2 SHORT ARC LENGTH = INCREASE AMPS = DECREASE ARC VOLTS
LONG ARC LENGTH = INCREASE ARC VOLTS = DECREASE AMPS

Student Competency Sheet

Unit III: OPERATING METALLIC AND TUNGSTEN INERT GAS WELDING EQUIPMENT (TIG), (MIG)

Module B: Welding with MIG Equipment

Task 2: WELD STAINLESS STEEL ALLOYS WITH GMAW (MIG) EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Set up the equipment.
3. Position all cables and hoses so as not to be burned or damaged.
4. Turn on electrical equipment.
5. Turn on and check water flow, as required.
6. Turn on and adjust the shielding gas.
7. Adjust wire feed, voltage, amperage, and stick out.
8. Weld joints using fillet and groove welds in all positions according to work order specifications.

Test

Items Needed:

1. Work order specifying dimensions, type of current, type of gas, and joint design
2. Safety equipment
3. GMAW (MIG) unit
4. Stainless steel alloys
5. Filler wire
6. Shielding gas

Task:

1. Weld stainless steel alloy joints using fillet and groove welds in all positions.
2. Weld stainless steel alloy joints to work order specifications using GMAW (MIG) unit.

Standard: Visual inspection of joints will show:

- a. Smooth and continuous welds.
- b. Complete penetration.
- c. Fusion between weld bead and base metal.
- d. No cracks, undercutting, or overlap.

Learning Activities

1. Read two (2) of the following:
   - a. The Procedure Hardbook of Arc Welding (Lincoln Electric Company), pp. 7.4-1 through 7.4-4.
   - b. Welding Principles and Practices (Sacks), pp. 847-849.

   c. Welding Procedures MIG & TIG (Schell/Matlock), pp. 149-179.
   d. Welding Skills and Practices (Giachino/Weeks), pp. 224-225.
   e. Welding Technology (Kennedy), pp. 528-531.

2. In Safety Notebook, list:

   a. Five (5) personal safety practices.
   b. Five (5) general shop safety practices.
   c. Safety equipment needed.

3. Observe demonstration by instructor:

   a. Setting up equipment.
   b. Material preparation.
   c. Welding stainless steel with MIG equipment.

4. Practice MIG welding stainless steel.

5. Obtain work order from instructor.

   a. Obtain safety equipment and specified steel; prep metal for welding.
   b. Weld with MIG equipment to work order specs.
   c. Submit to instructor for evaluation.

Student Competency Sheet

Unit III. OPERATING METALLIC AND TUNGSTEN INERT GAS WELDING EQUIPMENT (TIG), (MIG)

Module B: Welding with MIG Equipment

Task 3: WELD ALUMINUM OR ALUMINUM ALLOYS WITH GMAW (MIG) EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Set up the equipment.
3. Position all cables and hoses so as not to be burned or damaged.
4. Turn on electrical equipment.
5. Turn on and check water flow as required.
6. Turn on and adjust the shielding gas.
7. Adjust wire feed, voltage, amperage, and stick out.
8. Weld joints using fillet and groove welds in all positions according to work order specifications.

Test

Items Needed:
1. Work order specifying dimensions, type of current, type of gas, and joint design
2. Safety equipment
3. GMAW (MIG) unit
4. Filler wire
5. Aluminum workpiece

Task:
1. Weld aluminum joints using fillet groove welds in all positions.
2. Weld aluminum according to work order specifications, using a GMAW (MIG) unit.

Standard: Visual inspection will show:
- a. Smooth and continuous welds.
- b. Complete penetration.
- c. Fusion between weld bead and base metal.
- d. No cracks, undercutting or overlap.

Learning Activities

1. Read two (2) of the following:

   a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 9.3-1 through 9.3-7.
   b. Welding Principles and Practices (Sacks), pp. 841-847 and 904.
   c. Welding Procedures MIG & TIG (Schell/Matlock), pp. 116-148.
   d. Welding Skills and Practices (Giachino/Weeks), pp. 222-224.

   e. Welding Technology (Kennedy), pp. 521-524.

2. List in Safety Notebook:
   a. Five (5) personal safety practices.
   b. Five (5) general shop safety practices.
   c. Safety equipment needed.

3. Observe demonstration by instructor:
   a. Preparing metal for welding.
   b. Welding aluminum with MIG equipment.

4. Practice welding aluminum with MIG equipment.

5. Obtain work order from instructor.
   a. Obtain safety equipment and metal specified.
   b. Prep metal for welding according to specs.
   c. Set up MIG equipment.
   d. Perform weld according to specs.
   e. Submit project to instructor for evaluation.

6. As directed by instructor, repeat Learning Activity 5 in other positions.

Student Competency Sheet

Unit III: OPERATING METALLIC AND TUNGSTEN INERT GAS WELDING EQUIPMENT (TIG), (MIG)

Module C: Welding with TIG Equipment

Task 1: WELD CARBON STEELS WITH GTAW (TIG) EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Set up equipment.
3. Position all cables and hoses so as not to be burned or damaged.
4. Turn on electrical equipment.
5. Turn on and check water flow, as required.
6. Turn on and adjust shielding gas.
7. Adjust current.
8. Weld joints using fillet and groove welds in all positions according to work order specifications.

Test

Items Needed:
1. Work order specifying dimensions of metal and type of current
2. Safety equipment
3. GTAW (TIG) unit
4. Shielding gas
5. Tungsten electrode
6. Filler rod
7. Carbon steel rods

Task: Weld carbon steel alloy joints, according to work order specifications, using a GTAW (TIG) unit.

Standard: Visual inspection of joints will show:
- a. Smooth and continuous welds.
- b. Complete penetration.
- c. Fusion between the weld bead and base metal
- d. No cracks, undercutting, or overlap

Learning Activities

1. Read two (2) of the following:
   - a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 6.7-1 and 6.7-2.
   - b. Welding Principles and Practices (Sacks), pp. 774-775.
   - c. Welding Skills and Practices (Giachino/Weeks), pp. 186-187.
   - d. Welding Technology (Kennedy), pp. 468-471.

2. Attend lecture-discussions on the following. Take notes.
    a. Non-consumable electrode.
    b. Effect of heating and cooling on matter.
    c. Heat treating (transfer of heat).
    d. Forging and shaping (force and distortion).
    e. Fluids under pressure.
    f. Physical characteristics of inert gases; their function.

3. In Safety Notebook, list:
    a. Five (5) personal safety practices.
    b. Safety equipment needed.

4. Study and discuss:
    a. Information Sheet III-C-1 (GTAW Power Supply).
    b. Information Sheet III-C-1a (GTAW Electrodes--Tungsten Electrodes).
    c. Information Sheet III-C-1b (GTAW Electrodes--Prepare Electrode).
    d. Information Sheet III-C-1c (GTAW Process).

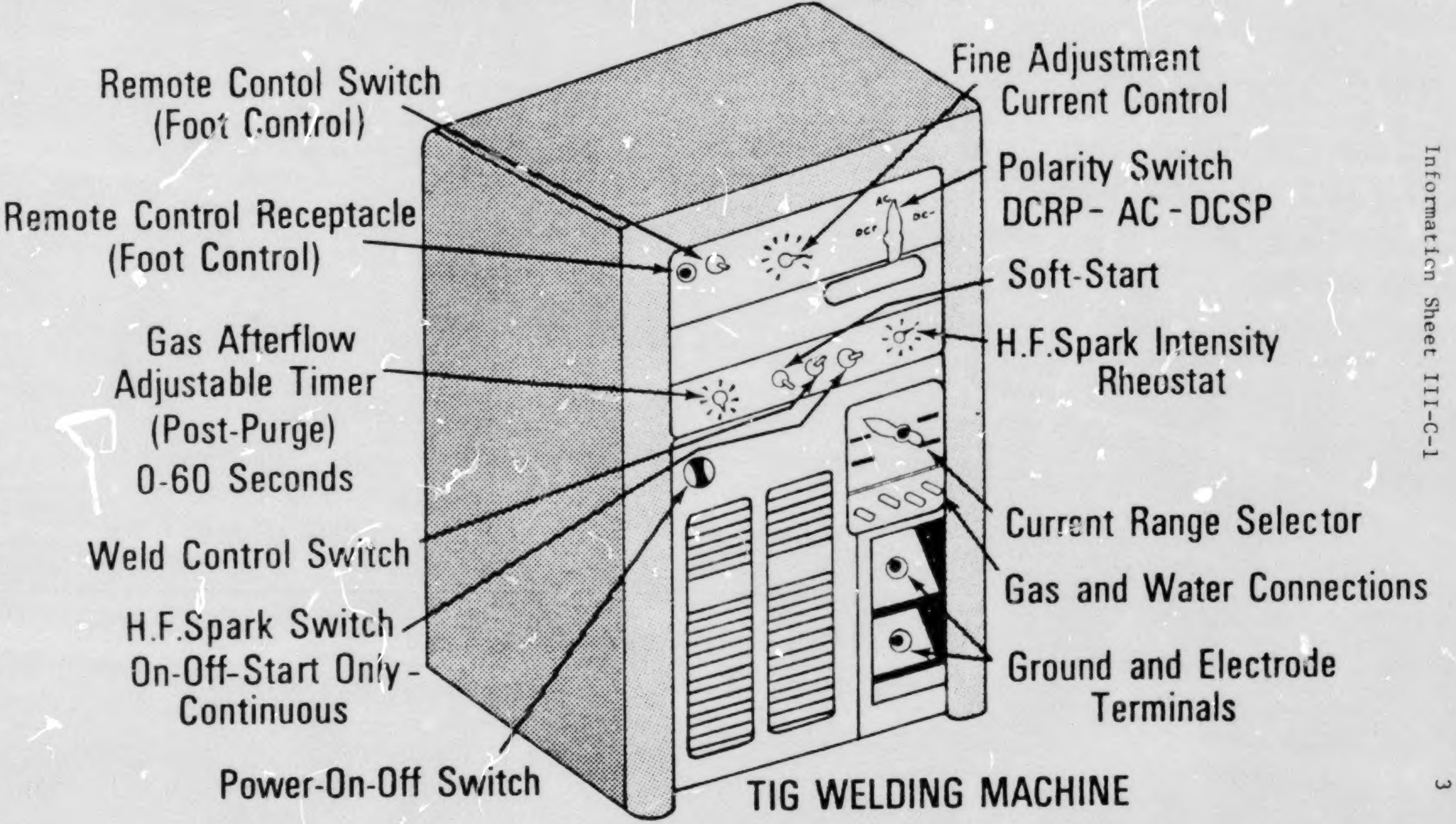
5. Observe demonstration by instructor:
    a. Preparing carbon steel for TIG welding.
    b. TIG welding carbon steels.

6. Practice TIG welding carbon steel in various positions.

7. Obtain work order from instructor:
    a. Select safety equipment.
    b. Obtain metal and prepare for welding.
    c. Set up TIG equipment.
    d. Perform weld to specs of work order.
    e. Submit project to instructor for evaluation.

8. As directed by instructor, repeat Learning Activity 7 in other positions.

GTAW Power Supply


Remote Contol Switch
(Foot Control)
Remote Control Receptacle
(Foot Control)
Gas Afterflow
Adjustable Timer
(Post-Purge)
0-60 Seconds
Weld Control Switch
H.F.Spark Switch
On-Off-Start Only - Continuous
Power-On-Off Switch
Fine Adjustment
Current Control
Polarity Switch
DCRP - AC - DCSP
AC
DCRP
DC-
Soft-Start
H.F.Spark Intensity
Rheostat
Current Range Selector
Gas and Water Connections
Ground and Electrode
Terminals

TIG WELDING MACHINE

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Information Sheet III-C-1a

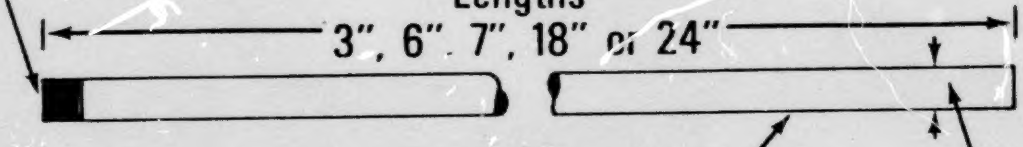
GTAW Electrodes

TUNGSTEN ELECTRODES

Electrodes Available

Color Code	Metal or Alloy
Green	Pure Tungsten
Yellow	1% Thorium
Red	2% Thorium
Brown	Zirconium

Lengths



Finish
Chemically Etched
Ground

Standard Diameters
Finishes and Lengths
1/16", 3/32", 1/8", 5/32", 3/16", and 1/4"

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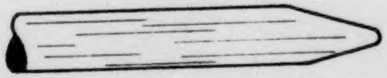
GTAW Electrodes

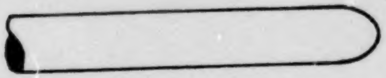
PREPARE ELECTRODE

A



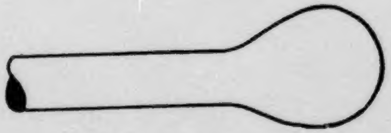
Good Condition- Pull point-with grind marks running lengthwise-(steel & stainless)

B



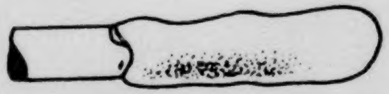
Good Condition- Shiny, round end-(aluminum & magnesium)

C



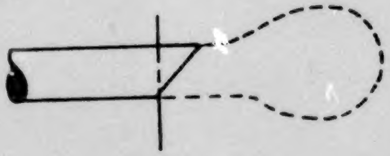
Too Much Current- Match head shape

D



End Contaminated With Base Metal-
Electrode touched puddle or filler rod
(similar to C, but uneven and longer)

E



Break off ends at dotted lines, if condition C or D exists. If electrode breaks at angle, grind off flat.

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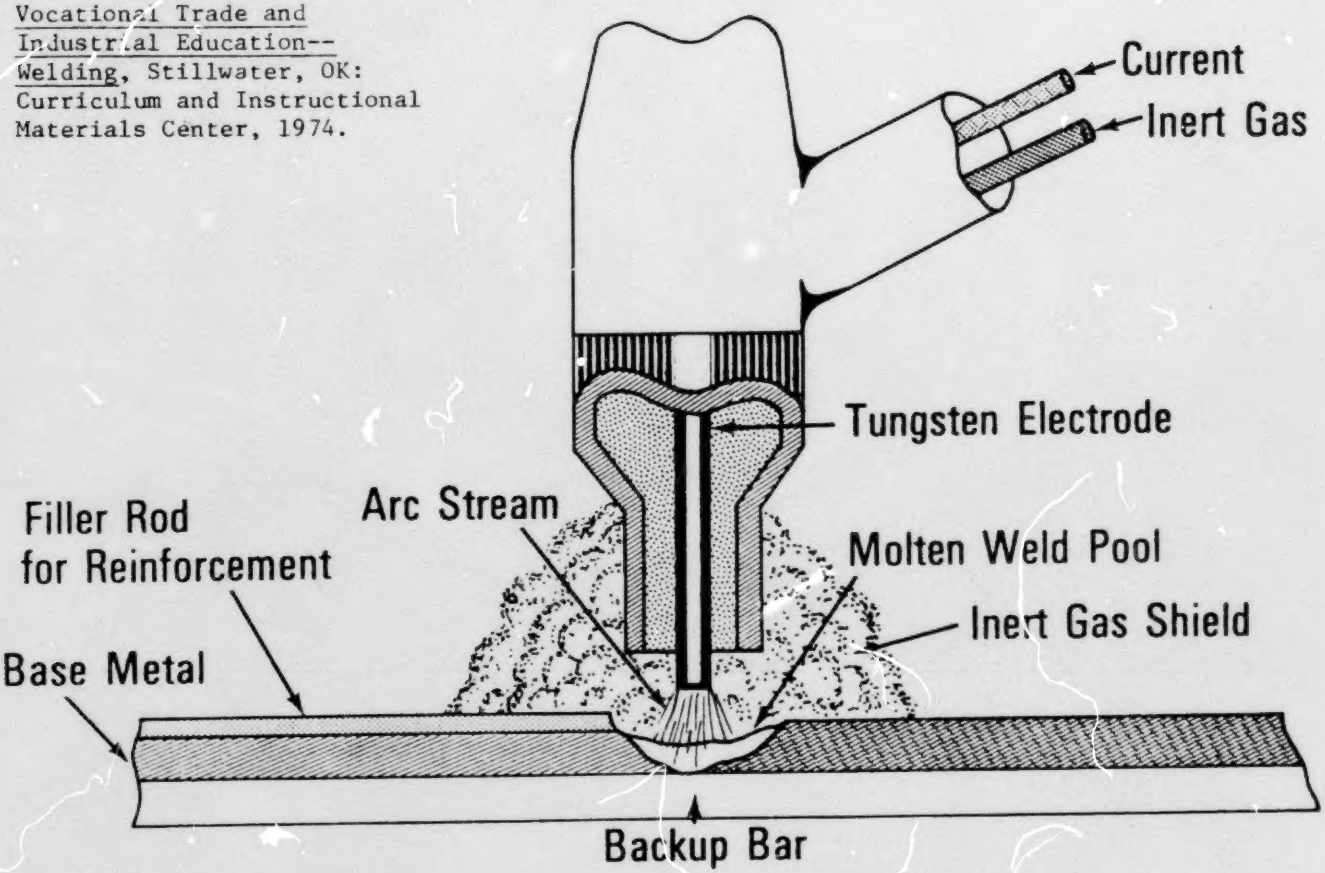
GTAW Process


Current
Inert Gas
Tungsten Electrode
Arc Stream
Filler Rod for Reinforcement
Molten Weld Pool
Inert Gas Shield
Base Metal
Backup Bar

Student Competency Sheet

Unit III: OPERATING METALLIC AND TUNGSTEN INERT GAS WELDING EQUIPMENT (TIG), (MIG)

Module C: Welding with TIG Equipment

Task 2: WELD ALUMINUM OR ALUMINUM ALLOYS WITH GTAW (TIG) EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Set up equipment.
3. Position all cables and hoses so as not to be burned or damaged.
4. Turn on electrical equipment.
5. Turn on and check water flow, as required.
6. Turn on and adjust shielding gas.
7. Adjust current.
8. Weld joints using fillet and groove welds in all positions according to work order specifications.

Test

Items Needed:
1. Work order specifying aluminum or aluminum alloys, dimensions of metal, type of current
2. Safety equipment
3. GTAW (TIG) unit
4. Shielding gas
5. Tungsten electrode
6. Filler rod

Task:
1. Weld aluminum joints using fillet and groove welds.
2. Weld aluminum joints according to work order specifications using GTAW (TIG) unit.

Standard: Visual inspection will show:
   a. Smooth and continuous welds.
   b. Complete penetration.
   c. Fusion between weld bead and base metal.
   d. No cracks, undercutting, or overlap.

Learning Activities

1. Read two (2) of the following:
   a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 9.4-1 through 9.4-11.
   b. Welding Principles and Practices (Sacks), pp. 773-774.

   c. Welding Procedures MIG & TIG (Schell/Matlock), pp. 200-239.
   d. Welding Skills and Practices (Giachino/Weeks), pp. 183-184.
   e. Welding Technology (Kennedy), pp. 442-446.

2. In Safety Notebook, list:

   a. Safety equipment needed.
   b. Five (5) personal safety practices.

3. Observe demonstrations by instructor of:

   a. Preparing material for TIG welding.
   b. Setting up TIG equipment.
   c. Welding aluminum.

4. Practice TIG welding aluminum.

5. Obtain work order from instructor:

   a. Select safety equipment.
   b. Obtain material and prepare for welding.
   c. Set up TIG equipment.
   d. Perform weld to specs of work order.
   e. Submit project to instructor for evaluation.

Student Competency Sheet

Unit III: OPERATING METALLIC AND TUNGSTEN INERT GAS WELDING EQUIPMENT (TIG), (MIG)

Module C: Welding with TIG Equipment

Task 3: WELD HEAT AND CORROSION RESISTANT (STAINLESS) STEELS WITH GTAW (TIG) EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Set up equipment.
3. Position all cables and hoses so as not to be burned or damaged.
4. Turn on electrical equipment.
5. Turn on and check water flow, as required.
6. Turn on and adjust shielding gas.
7. Adjust current.
8. Weld joints using fillet and groove welds in all positions according to work order specifications.

Test

Items Needed:

1. Work order specifying dimensions of metal and type of current
2. Safety equipment
3. GTAW (TIG) unit
4. Shielding gas
5. Tungsten electrode
6. Filler rod
7. Stainless steel alloy

Task: Weld stainless steel alloy joints, according to work order specifications, using a GTAW (TIG) unit.

Standard: Visual inspection of joints will show:

- a. Smooth and continuous welds.
- b. Complete penetration.
- c. Fusion between the weld bead and base metal.
- d. No cracks, undercutting, or overlap.

Learning Activities

1. Read two (2) of the following:

   a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 7.5-1 through 7.5-3.
   b. Welding Principles and Practices (Sacks), pp. 775-776.
   c. Welding Procedures MIG & TIG (Schell/Matlock), pp. 242-278.

   d. Welding Skills and Practices (Giachino/Weeks), p. 186.
   e. Welding Technology (Kennedy), pp. 466-468.

2. In Safety Notebook, list:

   a. Safety equipment needed.
   b. Five (5) personal safety practices.

3. Observe demonstrations by instructor of:

   a. Preparing stainless steel for TIG welding.
   b. Welding stainless steel with TIG equipment.

4. Practice TIG welding stainless steel.

5. Obtain work order from instructor.

   a. Select safety equipment.
   b. Obtain metal and prep for welding.
   c. Set up TIG equipment.
   d. Weld according to specs.
   e. Submit to instructor for evaluation.

6. As directed by instructor, repeat Learning Activity 5 in other positions.

Student Competency Sheet

Unit III: OPERATING METALLIC AND TUNGSTEN INERT GAS WELDING EQUIPMENT (TIG), (MIG)

Module C: Welding with TIG Equipment

Task 4: WELD COPPER OR COPPER ALLOYS WITH GTAW (TIG) EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Set up equipment.
3. Position all cables and hoses so as not to be burned or damaged.
4. Turn on electrical equipment.
5. Turn on and check water flow, as required.
6. Turn on and adjust shielding gas.
7. Adjust current.
8. Weld joints using fillet and groove welds according to work order specifications.

Test

Items Needed:

1. Work order specifying dimensions of metals and type of current
2. Copper alloys
3. GTAW (TIG) unit
4. Shielding gas
5. Tungsten electrode
6. Filler rod

Task: Weld copper alloy joints, according to work order specifications, using GTAW (TIG) unit.

Standard: Visual inspection of joints will show:

- a. Smooth and continuous welds.
- b. Complete penetration.
- c. Fusion between the weld bead and base metal.
- d. No cracks, undercutting, or overlap.

Learning Activities

1. Read two (2) of the following:
    - a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 10.1-6 through 10.1-8.
    - b. Welding Skills and Practices (Giachino/Weeks), pp. 184-185.
    - c. Welding Technology (Kennedy), pp. 472-473.

22

2. In Safety Notebook, list:
    a. Safety equipment needed.
    b. Five (5) safety practices.
3. Observe a demonstration by instructor.
4. Practice TIG welding copper and copper alloys.
5. Obtain work order from instructor.
    a. Select safety equipment.
    b. Obtain metal and prepare for welding.
    c. Set up TIG equipment.
    d. Perform weld to specs of work order.
    e. Submit project to instructor for evaluation.
6. As directed by instructor, repeat Learning Activity 5 in other positions.

Student Competency Sheet

Unit III: OPERATING METALLIC AND TUNGSTEN INERT GAS WELDING EQUIPMENT (TIG), (MIG)

Module C: Welding with TIG Equipment

Task 5: WELD CHROME-MOLY STEEL WITH GTAW (TIG) EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Set up equipment.
3. Position all cables and hoses so as not to be burned or damaged.
4. Turn on electrical equipment.
5. Turn on and check water flow, as required.
6. Turn on and adjust shielding gas.
7. Adjust current.
8. Weld joints using fillet and groove welds according to work order specifications.

Task

Items Needed:
1. Work order specifying dimensions of metal and type of current
2. Safety equipment
3. GTAW (TIG) unit
4. Chrome-moly alloy
5. Shielding gas
6. Tungsten electrode
7. Filler rod

Task: Weld Chrome-moly alloy joints, according to work order specifications, using a GTAW (TIG) unit.

Standard: Visual inspection will show:
- a. Smooth and continuous welds.
- b. Complete penetration.
- c. Fusion between the weld head and base metal.
- d. No cracks, undercutting, or overlap.

Learning Activities

1. Observe demonstration by instructor.

2. In Safety Notebook, list:

   a. Safety equipment needed.
   b. Five (5) safety practices.

3. Practice TIG welding chrome-moly steel.

4. Obtain work order from instructor.
    a. Select safety equipment.
    b. Obtain material and prepare for welding.
    c. Set up TIG equipment.
    d. Weld to specs of work order.
    e. Submit project to instructor for evaluation.
5. As directed by instructor, repeat Learning Activity 4 in other positions.

Student Competency Sheet

Unit III: OPERATING METALLIC AND TUNGSTEN INERT GAS WELDING EQUIPMENT (TIG), (MIG)

Module C: Welding with TIG Equipment

Task 6: WELD MAGNESIUM ALLOYS WITH GTAW (TIG) EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Set up equipment.
3. Position all cables and hoses so as not to be burned or damaged.
4. Turn on electrical equipment.
5. Turn on and check water flow, as required.
6. Turn on and adjust shielding gas.
7. Adjust current.
8. Weld joints using fillet and groove welds according to work order specifications.

Test

Items Needed:
1. Work order specifying dimensions of metal and type of current
2. Safety equipment
3. GTAW (TIG) unit
4. Shielding gas
5. Tungsten electrode
6. Filler rod
7. Magnesium alloy

Task: Weld magnesium alloy joints, according to work order specifications, using a GTAW (TIG) unit.

Standard: Visual inspection of joints will show:
- a. Smooth and continuous welds.
- b. Complete penetration.
- c. Fusion between the weld bead and base metal.
- d. No cracks, undercutting, or overlap.

Learning Activities

1. Read two (2) of the following:
    - a. Welding Principles and Practices (Sacks), pp. 776-777.
    - b. Welding Skills and Practices (Giachino/Weeks), p. 184.
    - c. Welding Technology (Kennedy), pp. 463-466.

2. In Safety Notebook, list:
    a. Safety equipment needed.
    b. Five (5) safety practices.
3. Observe demonstration by instructor.
4. Practice TIG welding magnesium.
5. Obtain work order from instructor.
    a. Select safety equipment.
    b. Obtain material and prep for welding.
    c. Set up TIG equipment.
    d. Perform weld according to specs in work order.
    e. Submit project to instructor for evaluation.
6. As directed by instructor, repeat Learning Activity 5 in other positions.
7. Discuss causes of the following errors:
    a. Wrong rotation.
    b. Wrong polarity.
    c. Overheating.
    d. Leaking weld contamination.
8. Inspect TIG-welded sample work pieces.
    a. Identify metal.
    b. Identify errors on flaws, if any.
    c. Discuss causes and correction.
9. All items on the Unit III Instructor Check Sheet must be completed and approved by the instructor.

Unit III

INSTRUCTOR CHECK SHEET: Place date activity is completed and approved in Approved column. Rate quality of performance 1 to 4 (1 is poor) in Quality column.

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
1. Oral safety quiz - safety practices.						
2. Set up MIG (GMAW) equipment.						
3. Disassemble and clean MIG torch.						
4. Weld carbon steel with GMAW (MIG): Low Carbon Butt Joint 1/4" Thickness Flat Position____						
___ Carbon ____ Joint ____ Thickness ____ Position____						
___ Carbon ____ Joint ____ Thickness ____ Position____						
Other - (Specify)						
5. Weld stainless with GMAW (MIG): Butt Joint 1/8" Thickness Flat Position____						
____ Joint ____ Thickness ____ Position____						
____ Joint ____ Thickness ____ Position____						
Other - (Specify)						
6. Weld aluminum with GMAW (MIG): Butt Joint 1/4" Thickness Flat Position____						
____ Joint ____ Thickness ____ Position____						
____ Joint ____ Thickness ____ Position____						
Other - (Specify)						
7. Set up TIG (GTAW) equipment.						
8. Disassemble and clean TIG torch.						

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
9. Weld carbon steel with TIG: Low Carbon Butt Joint 1/8" Thickness Flat Position ___						
___ Carbon ___ Joint ___ Thickness ___ Position ___						
___ Carbon ___ Joint ___ Thickness ___ Position ___						
Other - (Specify)						
10. Weld aluminum with TIG: Butt Joint 1/8" Thickness Flat Position ___						
___ Joint ___ Thickness ___ Position ___						
___ Joint ___ Thickness ___ Position ___						
___ Casting ___						
Other - (Specify)						
11. Weld stainless with TIG: Lapp Joint 1/16" Thickness Flat Position ___						
___ Joint ___ Thickness ___ Position ___						
___ Joint ___ Thickness ___ Position ___						
Other - (Specify)						
12. Weld copper with TIG: ___ Joint ___ Thickness ___ Position ___						
___ Joint ___ Thickness ___ Position ___						
___ Joint ___ Thickness ___ Position						
13. Weld crome-moly with TIG. Specify project - ___ ___						
14. Weld magnesium alloys with TIG: ___ Alloy ___ Joint ___ Thickness ___ Position ___						
___ Alloy ___ Joint ___ Thickness ___ Position ___						
Casting - (Specify) ___						
Casting ___						
Other						

UNIT IV

SET UP, TACK AND WELD METAL PROCESSING PROJECTS

Terminal Objectives

Upon completion of the modules in this unit, you will:

- Research technical publications for welding standards
- Draw sketches for shop or field projects
- Select metals for fabrication from blueprint specifications
- Clamp metal work to prevent distortion and tack weld
- Set up and tack weld tee joints
- Set up and tack weld lap joints
- Set up and tack weld open butt joints
- Set up and tack weld edge joints
- Set up and make a plug or slot weld
- Set up and tack weld in the flat position
- Set up and tack weld in the horizontal position
- Set up and tack weld in the vertical position
- Set up and tack weld in the overhead position

Student Competency Sheet

Unit IV: SET UP, TACK, AND WELD METAL PROCESSING PROJECTS

Module A: Organizing for Welding

Task 1: RESEARCH TECHNICAL PUBLICATIONS FOR WELDING STANDARDS

Performance Checklist

1. Select blueprint of a welding project.
2. Determine appropriate technical publication.
3. Locate and list appropriate sections, pages, and/or paragraphs.
4. Read and interpret.
5. Spec weld information on blueprint.

Test

Items Needed: 1. Technical publications
2. Blueprints of welding project
3. Paper
4. Pencil

Task: 1. Determine the types of welds required.
2. Research the technical publications for required, applicable standards.

Standards: Selected welds must comply with the requirements of the technical codes and standards.

Learning Activities

1. Read two (2) of the following:
   - a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 2.1-1 to 2.4-2.
   - b. Welding Principles and Practices (Sacks), pp. 23-44, 117-138, 427-451, 973-975.
   - c. Welding Skills and Practices (Giachino/Weeks), pp. 2-9, 19-54.
   - d. Welding Technology (Kennedy), pp. 13-32, 96-132.
2. Attend lectures by the instructor on:
   - a. Welding joints
   - b. Welding symbols
   - c. Blueprint reading
   - d. Codes and standards

3. Compile a list of organizations that write welding codes and standards which are used by welding firms in your area. List these on page "one" of class notebook.

4. Obtain blueprint with welding symbols:

   a. Determine welding standard utilized.
   b. Cross-reference standard to welding technique indicated; note section and page number of code used.
   c. Discuss, with classmates and instructor, your interpretation of code section.

5. Obtain blueprint lacking welding specs.

   a. Determine type of weld.
   b. Determine appropriate welding code or standard that applies to project.
   c. Determine possible welding techniques.
   d. Label weld with appropriate symbol; include reference to standard utilized.
   e. Compare your welding selection with:
      (1) Other classmates' selections.
      (2) Instructor's selection.

6. Learning Activities 4 and 5 can be repeated using simple to complex blueprints.

7. Review standards manuals published by:

   a. American Associated Highway Officials.
   b. American Bureau of Shipping.
   c. American Institute of Steel Construction.
   d. American Petroleum Institute.
   e. American Society for Testing Materials.
   f. American Welding Society.
   g. Society of Automotive Engineers.
   h. U.S. Department of the Navy.

Student Competency Sheet

Unit IV: SET UP, TACK, AND WELD METAL PROCESSING PROJECTS

Module A: Organizing for Welding

Task 2: DRAW SKETCHES FOR SHOP OR FIELD PROJECTS

Performance Checklist

1. Interpret requirements of work order.
2. Research manuals as required.
3. List material.
4. Draw sketch conforming to observed and measured specifications.
5. Check sketch and all measurements.

Test

Items Needed:
1. Work order
2. Necessary equipment
3. Technical manuals
4. Paper
5. Pencil

Task:
1. Draw a sketch for shop or field project according to work order.
2. Draw the sketch to scale.
3. Show welding symbols, lines, and views.

Standards:
1. Drawing will be neat and legible.
2. Symbols, lines, and views will meet the work order specifications with no errors.

Learning Activities

1. Read two (2) of the following:
   - a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 2.1-1 through 2.1-2, 2.1-6 through 2.1-7, 2.1-20 through 2.1-43, 2.2-1 through 2.4-2.
   - b. Welding Principles and Practices (Sacks), pp. 95-98, 117-137, and 403-452.
   - c. Welding Skills and Practices (Giachino/Weeks), pp. 42-54 and 420-437.
   - d. Welding Technology (Kennedy), pp. 112-132, 613-627, and 647-661.
2. Read one of the following:
   - a. Blueprint Reading for Welders (Bennett/Siy), pp. 7-32.
   - b. How to Read Shop Drawings (Lincoln Electric Company), pp. 1-21.

3. Observe a demonstration-lecture by instructor.

4. Obtain work order from instructor.

    a. Develop a sketch from work order.
    b. Determine appropriate standards which must be met.
    c. Label sketch with welding symbols and dimensions.
    d. Compare your sketch with other classmates' sketches.
    e. Submit sketch to instructor for evaluation.

Student Competency Sheet

Unit IV: SET UP, TACK, AND WELD METAL PROCESSING PROJECTS

Module A: Organizing for Welding

Task 3: SELECT METALS FOR FABRICATION FROM BLUEPRINT SPECIFICATIONS

Performance Checklist

1. Read and interpret blueprint specifications.
2. Identify metals from code numbers, e.g., A151, ASTM, SAE, AISI, Aluminum Association, AWS, ASME, or other governing agency.
3. Select appropriate material for processing.
4. Record on paper your selection.

Test

Items Needed:
1. Blueprint with specifications for types of metal for a fabrication job
2. Code book
3. Paper
4. Pencil

Task: Use the code book to select metals.

Standard: Your selection will comply with specifications on blueprint without error.

Learning Activities

1. Read two (2) of the following:
   a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 2.1-21 through 2.1-22 and 2.1-39 through 2.1-41.
   b. Welding Principles and Practices (Sacks), pp. 95, 101, and 403-452.
   c. Welding Technology (Kennedy), pp. 48-53 and 613-628.
2. Attend lectures by instructor and review notes from previous lectures and demonstrations on:
   a. Blueprint reading.
   b. Welding symbols.
   c. Metal identification and code numbers.
3. Obtain blueprint from instructor.
   a. Interpret blueprint specifications.
   b. Identify metals from code numbers.

c. Describe, in writing, why the specified metals are suitable for the piece to be constructed.
   (1) Include the properties of the specified materials.
   (2) Could more than one welding process be used? If so, list the alternative(s).

Student Competency Sheet

Unit IV: SET UP, TACK, AND WELD METAL PROCESSING PROJECTS

Module A: Organizing for Welding

Task 4: CLAMP METAL WORK TO PREVENT DISTORTION AND TACK WELD

Performance Checklist

1. Select safety and welding equipment.
2. Select clamps, firebricks, vises, and alignment fixtures as required.
3. Set up, align, and clamp work pieces.
4. Set up equipment and tack weld.

Test

Items Needed:

1. Work order
2. Safety equipment
3. Welding equipment
4. Clamps and alignment fixturing equipment
5. Necessary materials and tools
6. Firebricks
7. Vises
8. Metal work pieces

Task:

1. Set up equipment.
2. Align and clamp pieces.
3. Tack weld work pieces to prevent distortion.

Standard: Parts must be aligned, clamped, and tacked to compensate for heat distortion as per work order specifications.

Leraning Activities

1. Read two (2) of the following:
    a. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 2.1-4 through 2.1-5, 2.1-39, and 2.1-43.
    b. Welding Principles and Practices (Sacks), pp. 103-108, 125, 127, 131, and 804.
    c. Welding Technology (Kennedy), pp. 98-109, 117, and 248.
2. View DCA transparencies W-37 and W-44.
3. Attend demonstrations by instructor; review notes of previous demonstrations on:
    a. Distortion prevention.

- b. Clamping and preparing joints for welding.
- c. Tack welding:
  - (1) Oxy-fuel
  - (2) Shielded metal arc
  - (3) TIG and MIG

4. In Safety Notebook, list ten (10) personal safety practices.

5. Practice tack welding coupons, using:

   - a. Oxy-fuel.
   - b. Shielded metal arc.
   - c. TIG and MIG.

6. Have your instructor check your work (Learning Activity 5).

7. Obtain work order from instructor.

   - a. Select safety equipment.
   - b. Obtain material specified.
   - c. Align and clamp work to prevent distortion.
   - d. Have instructor inspect before welding.
   - e. Tack weld.
   - f. Check for distortion. If it occurs, determine why and how to prevent it.
   - g. Have instructor evaluate weld.

8. All items on the Module A Instructor Check Sheet must be completed and approved by the instructor.

Unit IV-Module A

INSTRUCTOR CHECK SHEET: Place date activity is completed and approved in Approved column. Rate quality of performance 1 to 4 (1 is poor) in Quality column.

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
1. Welding standards:						
2. Sketches for shop or field projects: (Specify)						
3. Selection of materials from drawings: Job #1						
Job #2						
Job #3						
4. Clamping metal to prevent distortion: Assignment #1						
Assignment #2						
Assignment #3						

Student Competency Sheet

Unit IV: SET UP, TACK, AND WELD METAL PROCESSING PROJECTS

Module B: Set up and Tack Weld Different Joints

Task 1: SET UP AND TACK WELD TEE JOINTS

Performance Checklist

1. Select safety and welding equipment.
2. Select clamps, fixtures, and tools.
3. Set up, align, and clamp work pieces in position.
4. Select correct rod and/or electrodes and set up equipment.
5. Tack weld pieces in position.

Test

Items Needed:

1. Work order
2. Safety equipment
3. Welding equipment
4. Necessary tools and materials
5. Clamps and fixturing devices

Task:

1. Set up welding equipment.
2. Align and clamp work pieces.
3. Tack tee joints.

Standard:

1. Tack welds will be properly spaced between plates.
2. There must be sufficient tacks to prevent distortion or warping as per work order specifications.

Learning Activities

1. Read two (2) of the following:
   a. Gas Welding (Giachino), pp. 22-33 and 81-89.
   b. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 2.1-3, 2.1-4, 2.2-1 through 2.2-8, 3.1-14, 6.2-15, 6.2-16, 6.6-2, 6.6-3, 7.2-4, 7.3-1, 7.3-2, 9.1-2, 13.4-2 through 13.4-4, 13.6-2 through 13.6-7.
   c. Welding Principles and Practices (Sacks), pp. 117-138.
   d. Welding Skills and Practices (Giachino/Weeks), pp. 39, 40, 47-48, 103, 116, 117, 174, 176, 212, 213, 221-420.
   e. Welding Technology (Kennedy), pp. 112-133, 246, 334-340, 352-361.
2. Observe demonstration by instructor.
3. In Safety Notebook, list five (5) personal safety practices.

4. Practice shielded arc welding using carbon steel coupons.

5. Practice welding coupons with oxy-fuel equipment.

6. Practice welding coupons with TIG equipment.

7. Practice welding coupons with MIG equipment.

8. Obtain blueprint of Tee weld project from instructor:

    a. Determine type of material specified.
    b. Obtain material and prep for welding.
    c. Select welding equipment.
    d. Set up equipment.
    e. Clamp and tack weld project.
    f. Examine for distortion and visual quality of weld (dye test).
    g. Submit to instructor for evaluation.

9. Repeat Learning Activity 8, using other metals (i.e., steel, copper, aluminum, etc.

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Student Competency Sheet

Unit IV: SET UP, TACK, AND WELD METAL PROCESSING PROJECTS

Module B: Set up and Tack Weld Different Joints

Task 2: SET UP AND TACK WELD LAP JOINTS

Performance Checklist

1. Select safety and welding equipment.
2. Select clamps, fixtures, and tools.
3. Set up, align, and clamp work pieces in position.
4. Select correct rod and/or electrodes and set up equipment.
5. Tack weld pieces in position.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Welding equipment
4. Clamps and fixturing devices
5. Necessary tools and materials
6. Metal work pieces

Task:
1. Set up equipment.
2. Align and clamp work pieces.
3. Tack weld lap joints.

Standard:
1. The tack welds will be properly spaced between plates.
2. There will be sufficient tacks to prevent distortion or warping as per work order specifications.

Learning Activities

1. Read one (1) of the following:
   - a. Gas Welding (Giachino), pp. 22-33 and 81-89.
   - b. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 6.3-9 through 6.3-17.
   - c. Welding Principles and Practices (Sacks), pp. 118, 119, 122, and 959.
   - d. Welding Skills and Practices (Giachino/Weeks), pp. 42, 48, 49, 116, 175, 178, 217, 220, and 420.
   - e. Welding Technology (Kennedy), pp. 112, 113, 232, 234, 246-247.
2. Observe demonstration by instructor.
3. List ten (10) safety practices in Safety Notebook.

4. Practice lap welding low carbon steel coupons with shielded arc equipment.

5. Practice lap welding low carbon steel coupons with oxy-fuel equipment.

6. Practice lap welding with TIG equipment.

7. Practice lap welding with MIG equipment.

8. Obtain blueprint of lap weld project from instructor.

   a. Determine type of material specified.
   b. Obtain material indicated and prep for welding.
   c. Select welding equipment.
   d. Set up equipment.
   e. Clamp and tack weld project.
   f. Examine for distortion and compliance to blueprint.
   g. Submit to instructor for evaluation.

9. Repeat Learning Activity 8, using other metals.

Student Competency Sheet

Unit IV: SET UP, TACK, AND WELD METAL PROCESSING PROJECTS

Module B: Set up and Tack Weld Different Joints

Task 3: SET UP AND TACK WELD OPEN BUTT JOINTS

Performance Checklist

1. Select safety and welding equipment.
2. Clean plates.
3. Grind proper root face.
4. Align plates on flat surface.
5. Space plates to proper root opening.
6. Select correct rod and/or electrode and set up equipment.
7. Place 1/2" (12.5mm) tack at each end.

Test

Items Needed:
1. Safety equipment
2. Welding equipment
3. Two 3/8" (10mm) x 6" 150mm) x 6" (150mm) plates
4. Cleaning materials

Task:
1. Set up two 3/8" (10mm) x 6" (150mm) x 6" (150mm) plates.
2. Align plates and tack weld open butt joints.

Standard: Dimensions must meet specifications of American Welding Society D1. 1-75, P. 60 and/or American Society of Mechanical Engineers, Section IX, Pg. 4-6-13.

Learning Activities

1. Read two (2) of the following:
   a. Gas Welding (Giachino), pp. 22-33 and 81-89.
   b. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 2.1-3, 2.3-1 through 2.3-7, and 7.3-1.
   c. Welding Principles and Practices (Sacks), pp. 118-121, 658-659, 732, 401, and 959.
   d. Welding Skills and Practices (Giachino/Weeks), pp. 42, 46-47, 116, 117, 175, 220, and 420.
   e. Welding Technology (Kennedy), pp. 112-113.
2. Observe demonstration by instructor.
3. In Safety Notebook, list five (5) personal safety practices.

4. Practice shielded arc welding butt weld of low carbon steel coupons.

5. Practice butt welding coupons with oxy-fule system.

6. Practice butt welding aluminum coupons with TIG system.

7. Practice butt welding coupons with MIG system.

8. Obtain blueprint of butt weld project from instructor.

    a. Determine type of material specified.
    b. Obtain material and prep for welding.
    c. Select welding equipment and safety equipment.
    d. Set up equipment.
    e. Clamp and tack according to specs.
    f. Submit to instructor for evaluation.

9. Repeat Learning Activity 8, using other metals.

Student Competency Sheet

Unit IV: SET UP, TACK, AND WELD METAL PROCESSING PROJECTS

Module B: Set up and Tack Weld Different Joints

Task 4: SET UP AND TACK WELD CORNER OR EDGE JOINTS

Performance Checklist

1. Select safety and welding equipment.
2. Clean plates as required.
3. Align plates with framing square and clamp into position.
4. Select correct rod and/or electrode and set up equipment.
5. Tack weld pieces in position.

Test

Items Needed:
1. Safety equipment
2. Welding equipment
3. Necessary tools and materials
4. Fixturing devices
5. Two 3/8 " (10mm) x 3" (75mm) x 6" (150mm) plates
6. Framing square

Task:
1. Set up two 3/8" (10mm) x 3" (75mm) x 6" (150mm) plates at right angles.
2. Tack weld plates in the 90° corner or edge joint position.

Standard:
1. Tack welds will be properly spaced between plates.
2. There will be sufficient tacks to prevent distortion or warping.

Learning Activities

1. Read two (2) of the following:

   a. Gas Welding (Giachino), pp. 22-33 and 81-89.
   b. The Procedure Handbook of Arc Welding (Lincoln Electric Company), pp. 2.1-3, 2.3-1 through 2.3-7.
   c. Welding Principles and Practices (Sacks), pp. 118, 119, 122, 123, and 959.
   d. Welding Skills and Practices (Giachino/Weeks), pp. 42, 49, 50, 174, 175, 178, and 420.
   e. Welding Technology (Kennedy), pp. 112-114.

2. Observe demonstration by instructor.

3. In Safety Notebook, list five (5) safety practices.

4. Practice edge and corner welding steel coupons with shielded arc system.

5. Practice edge and corner welding steel coupons with oxy-fuel system.

6. Practice edge and corner welding aluminum with TIG system.

7. Practice edge and corner welding aluminum with MIG system.

8. Obtain blueprint of corner weld from instructor.

    a. Determine type of material specified.
    b. Obtain material and prep for welding.
    c. Select welding equipment.
    d. Set up equipment.
    e. Clamp and tack according to specs.
    f. Submit project to instructor for evaluation.

9. Repeat Learning Activity 8.

    a. Use other metals.
    b. Use blueprint for edge joint.

Student Competency Sheet

Unit IV: SET UP, TACK, AND WELD METAL PROCESSING PROJECTS

Module B: Set up and Tack Weld Different Joints

Task 5: SET UP AND MAKE A PLUG OR SLOT WELD

Performance Checklist

1. Select safety and welding equipment.
2. Select two (2) pieces of 3/8" (10mm) plate approximately 4" (100mm) x 4" (100mm).
3. Clean as necessary.
4. Measure, mark, and cut 1" (25mm) hole in one (1) plate.
5. Place hole plate over solid plate and secure.
6. Select welding rod and set up machine.
7. Weld through hole.

Test

Items Needed:
1. Safety equipment
2. Welding equipment
3. Two (2) pieces of 3/8" (10mm) plate approximately 4" (100mm) x 4" (100mm)
4. SMAW machine
5. Oxy-acetylene cutting torch or drill press and bit

Task:
1. Measure, mark, and cut 1" (25mm) [illegible] in one (1) plate.
2. Set up for and make a plug or slot weld.

Standard:
1. Weldment filler must be flush.
2. Weld must meet hammer and chisel wedge test.

Learning Activities

1. Read two (2) of the following:

    a. Welding Principles and Practices (Sacks), pp. 953 and 961.
    b. Welding Skills and Practices (Giachino/Weeks), pp. 44, 425-427.
    c. Welding Technology (Kennedy), pp. 112 and 116.

2. Observe demonstration by instructor.

3. In Safety Notebook, list five (5) safety practices.

4. Practice slot and plug weld in low carbon steel with shielded arc equipment.

5. Practice slot and plug weld in low carbon steel with oxy-fuel equipment.

6. Practice slot and plug weld aluminum with MIG equipment.

7. Practice slot and plug weld aluminum with TIG equipment.

8. Obtain blueprint of slot weld project.

    a. Determine type of material specified.
    b. Obtain material and prep for welding.
    c. Select welding equipment.
    d. Set up equipment.
    e. Clamp and tack according to specs.
    f. Submit project to instructor for evaluation.

9. Repeat Learning Activity 8, using other metals.

Student Competency Sheet

Unit IV: SET UP, TACK, AND WELD METAL PROCESSING PROJECTS

Module C: Set up and Tack Weld in Different Positions

Task 1: SET UP AND TACK WELD IN THE FLAT POSITION

Performance Checklist

1. Select safety and welding equipment.
2. Select clamps, fixtures, and tools.
3. Set up, align, and clamp work pieces in position.
4. Select correct rod and/or electrode and set up equipment.
5. Tack weld pieces in position.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Welding equipment
4. Clamps and fixturing devices
5. Necessary tools and equipment
6. Metal work pieces

Task:
1. Set up welding equipment.
2. Align and clamp work pieces.
3. Tack weld work pieces in the flat position.

Standard:
1. The tack welds will be spaced between plates.
2. There will be sufficient tacks to prevent distortions or warping as per work order specifications.

Learning Activities

1. Read two (2) of the following:

   a. Gas Welding (Giachino), pp. 22-34.
   b. Welding Principles and Practices (Sacks), pp. 128, 329, 330, and 718-720.
   c. Welding Skills and Practices (Giachino/Weeks), pp. 97-108.
   d. Welding Technology (Kennedy), pp 125-126, 207, 227-231, and 334.

2. List five (5) safety practices in Safety Notebook.

3. Observe demonstrations by instructor:

   a. Butt weld
   b. Lap weld
   c. Tee weld
   d. Edge and corner

   (NOTE: All of the above can be done by oxy-fuel, shielded arc, TIG, and MIG systems.)

4. Practice the joint welds listed in Learning Activity 3 in flat position, using oxy-fuel system, shielded arc, TIG, and MIG.

5. Obtain work order from instructor.

    a. Determine type of joint and metal specified.
    b. Obtain metal, and prep for tack welding.
    c. Determine type of welding system to be used.
    d. Set up equipment, and tack weld sample.
    e. Submit project to instructor for evaluation.

6. Repeat Learning Activity 5, changing (as directed by instructor):

    a. Type of joint.
    b. Metal.

Student Competency Sheet

Unit IV: SET UP, TACK, AND WELD METAL PROCESSING PROJECTS

Module C: Set up and Tack Weld in Different Positions

Task 2: SET UP AND TACK WELD IN THE HORIZONTAL POSITION

Performance Checklist

1. Select safety and welding equipment.
2. Select clamps, fixtures, and tools.
3. Set up, align, and clamp work pieces in position.
4. Select correct rod and/or electrode and set up equipment.
5. Tack weld pieces in position

Test

Items Needed:
1. Work order
2. Safety equipment
3. Welding equipment
4. Clamps and fixturing devices
5. Necessary tools and materials
6. Metal work pieces

Task:
1. Set up welding equipment.
2. Align and clamp work piece.
3. Tack weld work pieces in the horizontal position.

Standard:
1. Tack welds will be spaced between plates.
2. There will be sufficient tacks to prevent distortion or warping as per work order specifications.

Learning Activities

1. Read:

   a. Gas Welding (Giachino), pp. 37-39.
   b. Welding Principles and Practices (Sacks), pp. 701-704.
   c. Welding Skills and Practices (Giachino/Weeks), pp. 50, 109-113, and 180-181.
   d. Welding Technology (Kennedy), pp. 125, 126, 227-232, and 353-357.

2. List five (5) safety practices in Safety Notebook.

3. Observe demonstration by instructor of:

   a. Butt weld
   b. Lap weld
   c. Tee weld
   d. Edge and corner

   (NOTE: All the above can be done by oxy-fuel, shielded arc, TIG, and MIG.)

4. Practice the joint welds listed in Learning Activity 3 in the horizontal position with oxy-fuel, shielded arc, TIG, and MIG systems.

5. Obtain work order from instructor.

    a. Determine metal specified.
    b. Obtain metal, and prep for welding.
    c. Determine type of welding equipment best suited for the material.
    d. Set up equipment, and tack weld sample.
    e. Submit project to instructor for evaluation.

6. Repeat Learning Activity 5, changing (as directed by instructor):

    a. Type of joint.
    b. Metal.

Student Competency Sheet

Unit IV: SET UP, TACK, AND WELD METAL PROCESSING PROJECTS

Module C: Set up and Tack Weld in Different Positions

Task 3: SET UP AND TACK WELD IN THE VERTICAL POSITION

Performance Checklist

1. Select safety and welding equipment
2. Select clamps, fixtures, and tools.
3. Set up, align, and clamp work pieces in position.
4. Select correct rod and/or electrode and set up equipment.
5. Tack weld pieces in position.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Welding equipment
4. Clamps and fixturing devices
5. Necessary tools and materials
6. Metal work pieces

Task:
1. Set up equipment.
2. Align and clamp work pieces.
3. Tack weld work pieces in the vertical position.

Standard:
1. The tack welds will be properly spaced between plates.
2. There will be sufficient tacks to prevent distortion or warping as per work order specifications.

Learning Activities

1. Read two (2) of the following:
    a. Gas Welding (Giachino), pp. 34-36.
    b. Welding Principles and Practices (Sacks), pp. 685-687 and 695-697.
    c. Welding Skills and Practices (Giachino/Weeks), pp. 50, 114-118, and 180.
    d. Welding Technology (Kennedy), pp. 125, 227, 231, 250, 343-349.
2. Observe demonstration by instructor of vertical welding of joints.
3. List five (5) safety practices in Safety Notebook.
4. Practice vertically welding the different types of joints using oxy-fuel, shielded arc, TIG, and MIG equipment.

5. Obtain work order from instructor.

   a. Determine metal specified.
   b. Obtain metal, and prep for welding.
   c. Select welding equipment.
   d. Set up equipment, and tack weld sample.
   e. Submit sample to instructor for evaluation.

6. Repeat Learning Activity 5 (as directed by instructor), changing:

   a. Type of joint.
   b. Metal.

Student Competency Sheet

Unit IV: SET UP, TACK, AND WELD METAL PROCESSING PROJECTS

Module C: Set up and Tack Weld in Different Positions

Task 4: SET UP AND TACK WELD IN THE OVERHEAD POSITION

Performance Checklist

1. Select safety and welding equipment.
2. Select clamps, fixtures, and tools.
3. Set up, align, and clamp work pieces in position.
4. Select correct rod and/or electrode and set up equipment.
5. Tack weld pieces in position.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Welding equipment
4. Clamps and fixturing devices
5. Necessary tools and materials
6. Metal work pieces

Task:
1. Set up equipment.
2. Align and clamp work pieces.
3. Tack weld work pieces in the overhead position.

Standard:
1. The tack welds will be properly spaced between plates.
2. There will be sufficient tacks to prevent distortion or warping as per work order specifications.

Learning Activities

1. Read two (2) of the following:

   a. Gas Welding (Giachino), pp. 40-42.
   b. Welding Principles and Practices (Sacks), pp. 688-695, 698, and 708-713.
   c. Welding Skills and Practices (Giachino/Weeks).
   d. Welding Technology (Kennedy), pp. 125, 227, 232, 347, 352.

2. List ten (10) safety practices in Safety Notebook.

3. Observe a demonstration by instructor of welding in overhead position.

4. Practice welding various joints in overhead position with oxy-fuel, shielded arc, TIG, and MIG equipment. Use all safety precautions.

5. Obtain work order from instructor.

   a. Determine type of material.
   b. Obtain material, and prep for welding.
   c. Determine type of welding equipment to be utilized.
   d. Set up welding equipment and tack weld.
   e. Submit project to instructor for evaluation.

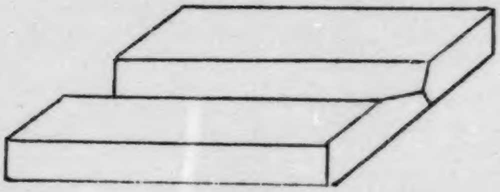
6. Repeat Learning Activity 5 (as directed by instructor), changing:

   a. Type of metal.
   b. Thickness of metal.
   c. Type of joint.
   d. Welding equipment.

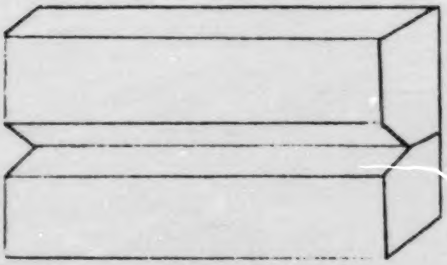
7. All items on the Module C Instructor Check Sheet must be completed and approved by the instructor.

Information Sheet IV-C-4

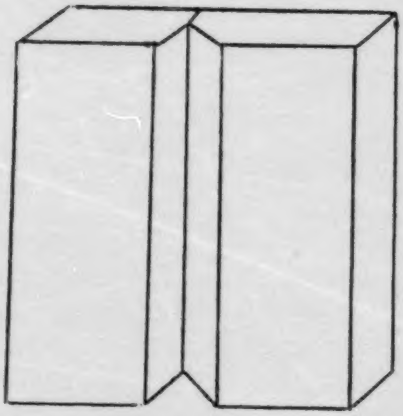
Welding Positions



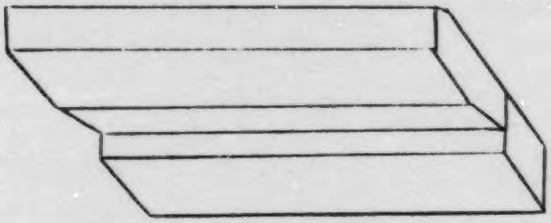
FLAT POSITION



HORIZONTAL POSITION



VERTICAL POSITION



OVERHEAD POSITION
(INVERTED)

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
c. MIG (GMAW)						
Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW)						
Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
3. Vertical Position						
a. Shield arc						
Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel						
Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW)						
Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW)						
Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
4. Overhead Position						
a. Shield arc						
Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						

Unit IV-Module C

INSTRUCTOR CHECK SHEET: Place date activity is completed and approved in Approved column. Rate quality of performance 1 to 4 (1 is poor) in Quality column.

ACTIVITY	DATE APPROVED	QUALITY 1	2	3	4	NUMBER OF ATTEMPTS
A. TEE JOINT						
1. Flat Position						
a. Shield arc						
Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel						
Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW)						
Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW)						
Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
2. Horizontal Position						
a. Shield arc						
Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel						
Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
b. Oxy fuel Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW) Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW) Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
B. LAP JOINT 1. Flat Position a. Shield arc Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW) Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW) Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
2. Horizontal Position a. Shield arc Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW) Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW) Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
3. Vertical Position a. Shield arc Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW) Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
d. TIG (GTAW)						
Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
4. Overhead Position						
a. Shield arc						
Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel						
Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW)						
Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW)						
Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
C. BUTT JOINT						
1. Flat Position						
a. Shield arc						
Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						

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INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
b. Oxy fuel Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW) Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW) Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
2. Horizontal Position a. Shield arc Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW) Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW) Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
3. Vertical Position						
a. Shield arc						
Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel						
Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW)						
Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW)						
Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
4. Overhead Position						
a. Shield arc						
Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel						
Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
c. MIG (GMAW) Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW) Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
D. CORNER OR EDGE 1. Flat Position a. Shield arc Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW) Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW) Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
2. Horizontal Position						
a. Shield arc						
Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel						
Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW)						
Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW)						
Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
3. Vertical Position						
a. Shield arc						
Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel						
Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW)						
Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
d. TIG (GTAW) Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
4. Overhead Position a. Shield arc Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW) Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW) Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
E. PLUG OR SLOT 1. Flat Position a. Shield arc Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY 1	2	3	4	NUMBER OF ATTEMPTS
b. Oxy fuel Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW) Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW) Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
2. Horizontal Position a. Shield arc Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW) Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW) Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
3. Vertical Position						
a. Shield arc						
Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel						
Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW)						
Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						
d. TIG (GTAW)						
Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						
4. Overhead Position						
a. Shield arc						
Low carbon steel 1/4" thickness						
Low carbon steel 1/2" thickness						
Casting						
Other						
b. Oxy fuel						
Low carbon steel 1/8" thickness						
Low carbon steel 1/4" thickness						
Other						
c. MIG (GMAW)						
Aluminum 1/8" thickness						
Aluminum 1/4" thickness						
Other						

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY 1	QUALITY 2	QUALITY 3	QUALITY 4	NUMBER OF ATTEMPTS
d. TIG (GTAW) Aluminum 1/8" thickness						
Aluminum ____ thickness						
Magnesium casting						
Aluminum casting						

UNIT V

CLEAN, TEST AND CLASSIFY METALS

Terminal Objectives

Upon completion of the modules in this unit, you will:

- Examine and identify metals
- Clean metals with solvent
- Test metals, using the guided bend tester
- Inspect welds, using dye penetrant methods

Student Competency Sheet

Unit V: CLEAN, TEST, AND CLASSIFY METALS

Module A: Clean, Test, and Classify Metals

Task 1: EXAMINE AND IDENTIFY METALS

Performance Checklist

1. Select proper safety equipment.
2. Obtain metals to be tested.
3. Determine correct method for testing.
4. Test and identify metals.
5. Record findings and test used.

Test

Items Needed:
1. Safety equipment
2. Testing equipment
3. Minimum of five (5) metal specimens

Task:
1. Select correct method for testing.
2. Identify metal specimens visually, mechanically, or chemically.

Standard: Identify three (3) of the five (5) metals correctly.

Learning Activities

1. Read two (2) of the following:
    a. Modern Welding (Althouse/Turnquist/Bowditch), pp. 24-1 through 24-26.
    b. The Procedure Handbook of Arc Welding (Lincoln Electric Co.), pp. 1.2-1 through 1.2-8.
    c. Welding Principles and Practices (Sacks), pp. 75-101.
    d. Welding Skills and Practices (Giachino/Weeks), pp. 19-40.
    e. Welding Technology (Kennedy), pp. 33-79.
2. In the Terms and Definitions Notebook, list terms found in reading assignment.
3. Write, in notebook, visual characteristics of the following:
    a. Steel (low, medium, and high carbon)
    b. Cast iron
    c. Aluminum
    d. Copper

4. Observe, and take notes on, demonstrations by instructor of:
    - a. Mechanical testing - grind test and tensile test
    - b. Chemical testing

5. In Safety Notebook, list safety practices demonstrated/explained by instructor.

6. Write a research paper on the steel code classifying system. Sub-topics could include:
    - a. Origin and development.
    - b. Users and uses.
    - c. Description of the system, etc.

7. Obtain five (5) metal specimens from instructor:
    - a. Test specimens (visually, mechanically, or chemically).
    - b. Identify by name and code.
    - c. Identify by recommended usage.
    - d. Identify by type of welding system(s) that can be applied.
    - e. Have your instructor evaluate your work.

Student Competency Sheet

Unit V: CLEAN, TEST, AND CLASSIFY METALS

Module A: Clean, Test, and Classify Metals

Task 2: CLEAN METALS WITH SOLVENT

Performance Checklist

1. Select safety equipment.
2. Obtain cleaning fluid (acetone or lacquer thinner).
3. Clean work piece with appropriate cleaning fluid.
4. Dry thoroughly.
5. Replace flammable cleaning fluids in paint locker or remove from welding area.

Test

Items Needed:
1. Safety equipment
2. Metal work piece requiring cleaning
3. Appropriate cleaning fluid

Task: Clean metal work piece with solvents.

Standard: Metal will be free of all contaminating substance.

Learning Activities

1. Observe demonstration by instructor of cleaning metals with solvents.

2. Discuss uses of various solvents for particular kinds of metals:

   a. What are the chemical reactions?
   b. What are the environmental hazards/precautions?
   c. What are the personal safety hazards/precautions?

3. In Safety Notebook, list:

   a. Five (5) safety practices for using acetone.
   b. Five (5) safety practices for using lacquer thinner.
   c. Safety equipment.

4. Practice cleaning metals with solvents, as directed by instructor.

5. Obtain a metal work piece from your instructor:

   a. Determine type of metal.
   b. Select appropriate cleaning solvent and method.
   c. Clean the metal.
   d. Have your instructor evaluate your work.

Student Competency Sheet

Unit V: CLEAN, TEST, AND CLASSIFY METALS

Module A: Clean, Test, and Classify Metals

Task 3: TEST METALS USING GUIDED BEND TESTER

Performance Checklist

1. Select safety equipment.
2. Select necessary tools and equipment.
3. Select test plate.
4. Select cutting method.
5. Cut specimens.
6. Machine grind specimens as required.
7. Place specimens in machine and bend as required.
8. Record results of test.

Test

Items Needed:

1. Safety equipment
2. Necessary tools and equipment
3. Test plate
4. Guided bend tester
5. American Weld Society Code Dl. 1-75
6. American Society of Mechanical Engineers, Sect IX. Q W 160, p. 1-3.

Task:

1. Remove and prepare specimens from test plate according to applicable code.
2. Place samples in bend tester.
3. Bend specimens according to:
    a. Code instructions, or
    b. Requirements of the American Welding Society Code Dl. 1-75, and American Society of Mechanical Engineers, Sect. IX, Q W 160, p. 1-3.

Standard: Results of test will meet the applicable code.

Learning Activities

1. Read two (2) of the following:

    a. Modern Welding (Althouse/Turnquist/Bowditch), pp. 22-10 to 22-11.
    b. Welding Principles and Practices (Sacks), pp. 384-385.
    c. Welding Skills and Practices (Giachino/Weeks), pp. 410-412.
    d. Welding Technology (Kennedy), p. 639.

2. Observe demonstration by instructor on preparing test plates and performing test using guided bend tester.

3. Discuss:

   a. Types of weld errors that can be diagnosed by bend test.
   b. Causes of the errors.
   c. Corrective measures.

4. In Safety Notebook, list:

   a. Five (5) personal safety practices.
   b. Five (5) general shop practices.

5. Write procedure for bend testing weld in notebook. Include:

   a. Safety practices
   b. Evaluating

6. Practice bend tests.

7. Obtain test specimen:

   a. Cut and grind test plate.
   b. Bend test to code specs.
   c. Evaluate weld based on code specs.

Student Competency Sheet

Unit V: CLEAN, TEST, AND CLASSIFY METALS

Module A: Clean, Test, and Classify Metals

Task 4: INSPECT WELDS USING DYE PENETRANT METHODS

Performance Checklist

1. Select safety equipment.
2. Obtain dye penetrant materials and sample weld.
3. Clean weld with solvent.
4. Spray dye on weld.
5. Allow time to dry, following manufacturer's recommendation.
6. Clean surface with lint free rag and proper cleaning solution.
7. Spray developer solution (follow manufacturer's recommendation).
8. Examine surface for cracks and porosity.
9. Measure length of cracks and diameters of porosity holes, and compare with standard.
10. Record findings in writing.

Test

Items Needed:
1. Safety equipment
2. Sample weld
3. Dye penetrant kit
4. Cleaning solvent
5. Lint free rag
6. Developer solution
7. Measuring instruments
8. Pencil
9. Paper
10. American Welding Society Handbook
11. American Society of Welding Engineers Handbook

Task:
1. Clean weld with solvent.
2. Inspect weld for defects using dye penetrant method.
3. Compare weld defects with code standards found in American Welding Society Welding Handbook, Chapter 10 or American Society of Mechanical Engineers, Section V, Article 6, pp. 27-30.

Standard: Your written findings must agree with the instructor's

---

Learning Activities

1. Read two (2) of the following:

    a. Modern Welding (Althouse/Turnquist/Bowditch), p. 22.5.
    b. The Procedure Handbook of Arc Welding (Lindoln Electric Co.), pp. 11.2-13 to 11.2-14.
    c. Welding Skills and Practices (Giachino/Weeks), pp. 415-416.

2. Observe a demonstration by instructor.

3. In Safety Notebook, list five (5) safety practices.

4. In notebook, write procedure for dye penetrant test.

5. Practice dye test.

6. Obtain weld specimen from instructor:

    a. Perform dye test.
    b. Write evaluation of weld and submit evaluation and specimen to instructor.

7. All items on the Module A Instructor Check Sheet must be completed and approved by the instructor.

INSTRUCTOR CHECK SHEET (Continued)

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
b. Type of welding equipment used__________ Type of material__________ Type of penetrant dye						
c. Type of welding equipment used__________ Type of material__________ Type of penetrant dye						

Unit V-Module A

INSTRUCTOR CHECK SHEET: Place date activity is completed and approved in Approved column. Rate quality of performance 1 to 4 (1 is poor) in Quality column.

ACTIVITY	DATE APPROVED	QUALITY 1	2	3	4	NUMBER OF ATTEMPTS
1. Identify metal: a. High carbon steel						
b. Low carbon steel						
c. Hot rolled steel						
d. Cold rolled steel						
e. Aluminum-roll						
f. Aluminum-casting						
g. Copper						
h. Brass						
i. Cast iron						
j. Magnesium						
k. Stainless steel						
2. Clean metals with solvent: a. Type of metal ____________						
b. Type of metal ____________						
c. Type of metal ____________						
3. Test metals using guided band tester: a. Type of welding equipment used ____________ Type of metal ____________ Type of joint ____________ Other - (Specify)						
b. Type of welding equipment used ____________ Type of metal ____________ Type of joint ____________ Other - (Specify)						
c. Type of welding equipment used ____________ Type of metal ____________ Type of joint ____________ Other - (Specify)						
4. Penetrant dye test: a. Type of welding equipment used ____________ Type of material ____________ Type of penetrant dye						

UNIT VI

OPERATING AUXILIARY EQUIPMENT AND TOOLS

Terminal Objectives

Upon completion of the modules in this unit, you will use safe procedures to:

- Cut materials with hand hacksaws
- Chip slag, using a chipping hammer
- Finish metal surfaces with hand tools
- Shear and punch metal shapes, using iron working machines
- Drill metal, using power drilling equipment
- Cut metal with a power hacksaw or a band saw
- Grind metal with power equipment
- Set oven temperature and store arc electrodes

Student Competency Sheet

Unit VI: OPERATING AUXILIARY EQUIPMENT AND TOOLS

Module A: Hand Tools

Task 1: CUT MATERIALS WITH HAND HACKSAWS

Performance Checklist

1. Select safety equipment.
2. Select required tools and equipment.
3. Measure and mark material to be cut.
4. Select proper blade.
5. Secure blade in frame.
6. Properly secure work to be cut.
7. Cut metal using the correct draw angle and stroke speed.

Test

Items Needed:
1. Safety equipment
2. Required tools and equipment
3. Piece of metal
4. Hand hacksaw

Task:
1. Measure and mark metal for length specified by your instructor.
2. Cut metal to specified length using hand hacksaw.

Standard: Metal cut will be ± 1/16" (1.5mm) of the specified length.

Learning Activities

1. Read:
   a. Machine Shop Operations (Krar/Oswald/St. Amand), pp. 14-15.
   b. Machine Shop Theory and Practices (Wagener and Arthur), pp. 252-254.
   c. Modern Metalworking (Walker), pp. 9-1 to 9-5.
   d. Shop Theory (Nicholson), Chapter 3.
2. Observe demonstration by instructor on selection and use of hand hacksaws.
3. In Safety Notebook, list:
   a. Three (3) personal safety practices.
   b. Three (3) general shop safety practices.

4. Identify (to instructor or classmate):
   - a. Types of frames available.
   - b. Methods by which blades are identified.
   - c. Types of blades available.

5. Obtain work order from instructor:
   - a. Obtain material.
   - b. Select correct blade.
   - c. Cut material to specs ± 1/16".
   - d. Submit cut material to instructor for evaluation.

Student Competency Sheet

Unit VI: OPERATING AUXILIARY EQUIPMENT AND TOOLS

Module A: Hand Tools

Task 2: CHIP SLAG USING CHIPPING HAMMER

Performance Checklist

1. Select safety equipment.
2. Select chipping hammer.
3. Check condition of chipping hammer.
4. Chip slag from weld using side-by-side method
5. Brush to clean as required.

Test

Items Needed:
1. Safety Equipment
2. Welded joint
3. Chipping hammer

Task: Chip slag from freshly cooled weld.

Standard: Weldment must be free of all removable slag.

Learning Activities

1. Read:
    a. Electric Arc Welding (Austin), pp. 49-51.
    b. New Lessons in Arc Welding (Lindoln Electric Co.), p. 1.6.
    c. Welding Principles and Practices (Sacks), pp. 343-345.

2. Observe a demonstration by instructor on selection and use of chipping hammer.

3. In Safety Notebook, list:
    a. Three (3) personal safety practices.
    b. Three (3) general shop safety practices.
    c. Safety equipment needed.

4. Discuss (with instructor and classmates):
    a. Types of chipping hammers.
    b. Correct method of use.
    c. When to perform chipping.
    d. Required safety equipment and practices.

5. Practice using chipping hammer.

6. From your instructor, obtain welded joint(s) requiring chipping:

    a. Clean joint with hammer.
    b. Submit finished joint to instructor for evaluation.

Student Competency Sheet

Unit VI: OPERATING AUXILIARY EQUIPMENT AND TOOLS

Module A: Hand Tools

Task 3: FINISH METAL SURFACES WITH HAND TOOLS

Performance Checklist

1. Select safety equipment.
2. Select files, wire brushes and various grades of abrasive materials.
3. Rough finish surface of workpiece with files.
4. Smooth finish with abrasive material.
5. Polish as required.

Test

Items Needed:

1. Safety equipment
2. Necessary tools and materials
3. Welded metal surface
4. Files
5. Wire brushes
6. Various grades of emery cloth, metalite cloth, silicon-carbide paper, and crocus cloth

Task:

1. Select necessary tools and materials.
2. File and polish metal surfaces (weldments) with hand tools.

Standard: Weldment will be smooth with no distinguishable weld lines.

Learning Activities

1. Read:
    a. Machine Shop Operations (Krar/Oswald/St. Amand), pp. 50-51.
    b. Machine Shop Theory and Practices (Wagener/ Arthur), pp. 250-252.
    c. Shop Theory (Nicholson), Chapter 4.
2. Observe demonstrations by instructor;
    a. Use of hand files and brushes.
    b. Use of abrasive cloth.
3. List five (5) safety practices in Safety Notebook.

4. Identify (on paper or to instructor):
    a. Types of files available (and uses).
    b. Cuts available on files (and uses).
    c. Types of abrasive materials (and uses).
    d. Safety practices.

5. From your instructor, obtain metal to be surface-prepared by hand:
    a. Select materials to be utilized; i.e., wire-brush, files, abrasive cloth.
    b. Clean surface.
    c. Submit metal to instructor for evaluation.

Student Competency Sheet

Unit VI: OPERATING AUXILIARY EQUIPMENT AND TOOLS

Module B: Power Tools

Task 1: SHEAR AND PUNCH METAL SHAPES USING IRON WORKING MACHINE(S)

Performance Checklist

1. Select safety equipment.
2. Select raw stock.
3. Measure and mark stock.
4. Set up machine(s).
5. Shear and punch as per project work order.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Iron Working machine(s)
4. Necessary tools
5. Raw metal stock
6. Measuring instrument

Task:
1. Set up iron working machine.
2. Measure and mark metal as specified by the work order.
3. Punch and shear metal according to work order specifications.

Standard: Metal will be marked, punched, and sheared to a tolerance of ± 1/16" (1.5mm).

Learning Activities

1. Read:
   a. Welding Principles and Practices (Sacks), pp. 348-353.
   b. Welding Technology (Kennedy), pp. 26-5 to 26-7.

2. Observe demonstrations by instructor on usage/procedures for:
   a. Power shears
   b. Portable nibbling

3. Study Information Sheet VI-B-1 (Squaring Shears), then:
    a. Identify parts on actual model; explain their functions.
    b. Practice setting up the machine to instructor's specifications.
    c. Discuss the consequences of mechanical errors (personal safety, quality control, etc.)

4. In Safety Notebook, list:
    a. Five (5) personal safety practices.
    b. Three (3) general shop safety practices.
    c. Safety equipment needed.

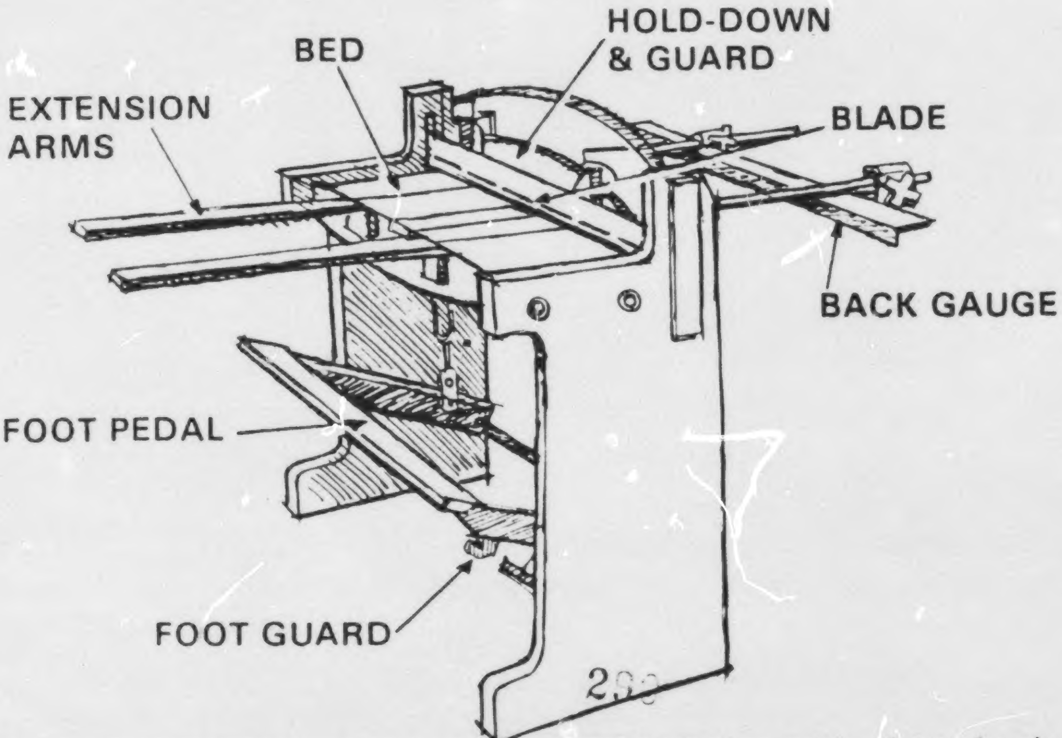
5. Practice measuring and marking metals according to specs provided by your instructor.

6. Practice using power shears and portable nibbling tool.

7. Obtain work order from instructor:
    a. Obtain material specified.
    b. Cut material as specified.
    c. Submit cut metal to instructor for evaluation.

Information Sheet VI-B-1 -- Squaring Shears

1. **Operate only with instructors permission and after you have received instruction.**
2. **Remove jewelry, eliminate loose clothing, and confine long hair.**
3. **Make sure all guards are in place and operating correctly.**
4. **Always use proper eye protection.**
5. Check the machine and the setup before operating. If needed, get a helper.
6. Never exceed the capacity of the machine.
7. Use gloves when handeling large pieces of sheet metal, and remove obvious burrs from all pieces.
8. Keep fingers at least 3" away from pressure bar—hold down-guard—and blade.
9. Do not atempt to catch small pieces, allow them to fall to the floor.
10. Operate only from the front of the machine.
11. Keep area under and around the machine clean and feet out from under the foot pedel.



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Student Competency Sheet

Unit VI: OPERATING AUXILIARY EQUIPMENT AND TOOLS

Module B: Power Tools

Task 2: DRILL METAL USING POWER DRILLING EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Accurately measure and center punch hole on metal.
3. Properly secure work.
4. Select bit and set up drill press.
5. Operate drill press at proper speed and pressure.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Drill press
4. Metal

Task:
1. Center punch and secure metal.
2. Drill hole as specified by your instructor.

Standard: Drilled hole will be ± 1/32" (.75mm) of specified location.

Learning Activities

1. Read:
   a. *Machine Shop Operations* (Krar/Oswald/St. Amand), pp. 21-33.
   b. *Machine Tool Technology* (McCarthy/Smith), Units 38 through 47.
   c. *Modern Metalworking* (Walker), pp. 34-1 to 34-24.
   d. *Welding Principles and Practices* (Sacks), pp. 346-355.
2. Observe demonstrations by instructor on:
   a. Use of electric hand drill.
   b. Use of drill press.
3. Study Information Sheet VI-B-2 (Portable Electric Drill), then:
   a. Identify parts on actual model; explain their functions.
   b. Discuss durability and serviceability of various brands.
   c. Practice selecting and inserting drill bits needed to drill to specs provided by instructor.
   d. Discuss the consequences of errors in measuring and drilling.

4. Study Information Sheet VI-B-2a (Drill Press), then:
   a. Identify parts on actual model, explain their functions.
   b. Identify and practice using safety controls.
   c. Practice setting up the press to drill to specs provided by your instructor.
   d. Discuss the consequences of errors in measuring, drilling, and press operation.

5. List in Safety Notebook:
   a. Five (5) personal safety practices.
   b. Five (5) general shop safety practices.
   c. Safety equipment needed.

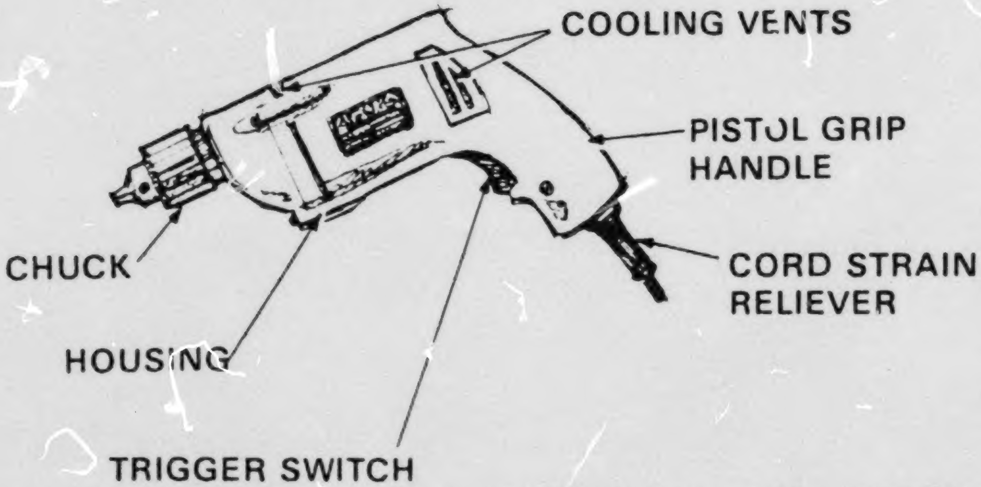
6. Under the supervision of your instructor:
   a. Practice using portable electric drill.
   b. Practice setting up and using drill press.

7. Measure and mark metal samples for drilling according to specs provided by instructor.

8. Obtain work order from instructor:
   a. Obtain material.
   b. Layout material to specs.
   c. Drill to specs.
   d. Submit finished product to instructor for evaluation.

Information Sheet VI-B-2 -- Portable Electric Drill

1. **Operate only with instructors permission and after you have received instruction.**
2. **Remove jewelry, eliminate loose clothing, and confine long hair.**
3. **Make sure all guards are in place and operating correctly.**
4. **Always use proper eye protection.**
5. "Unplug" the drill when changing bits.
6. Make sure switch is off and key removed before connecting to power source.
7. Mark hole location with center punch (metal) or AWL (wood) before drilling.
8. Be sure work is tightly clamped or secure before drilling.
9. Drill with straight even steady pressure.


COOLING VENTS
PISTOL GRIP HANDLE
CHUCK
CORD STRAIN RELIEVER
HOUSING
TRIGGER SWITCH

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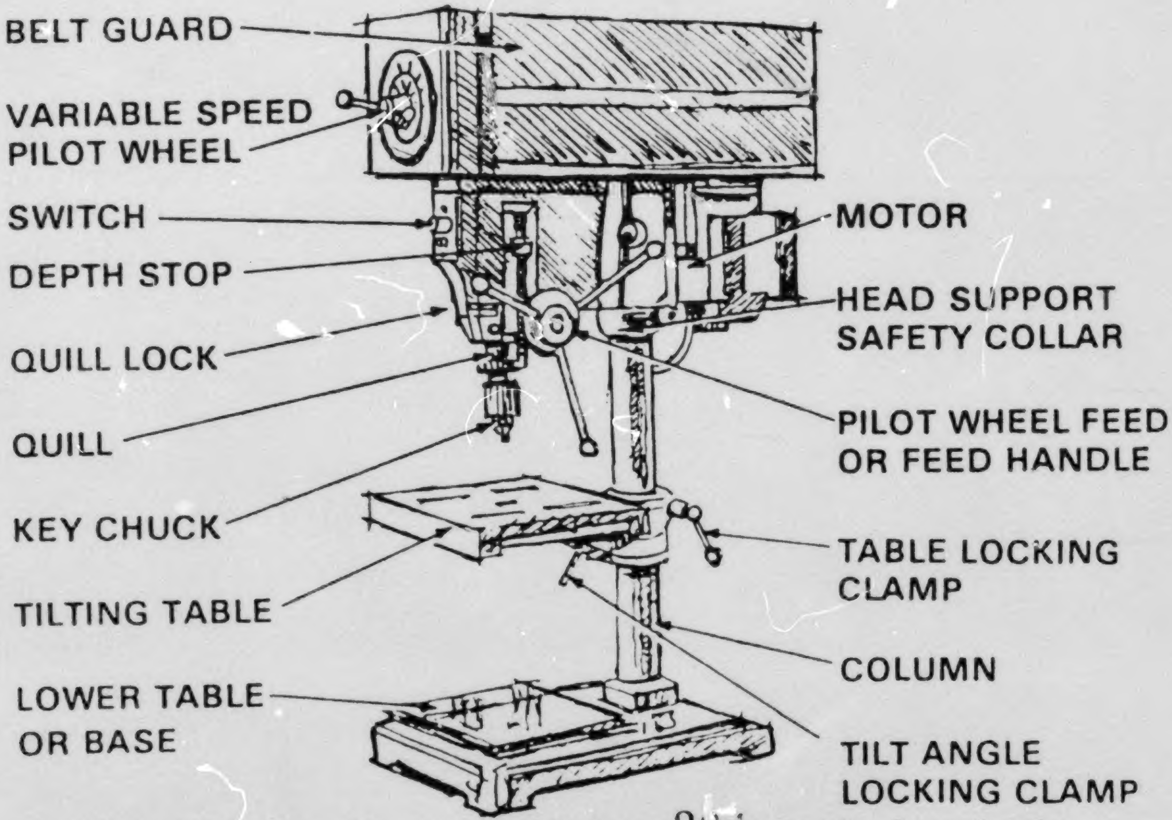
Information Sheet VI-B-2a -- Drill Press

1. **Operate only with instructors permission and after you have received instruction.**
2. **Remove jewelry, eliminate loose clothing, and confine long hair.**
3. **Make sure all guards are in place and operating correctly.**
4. **Always use proper eye protection.**
5. Hold material securely with vise or clamps.
6. Be sure key is removed from chuck.
7. Select a properly sharpened bit. For metal, center punch when hole is to be drilled.
8. Turn off power if work piece is caught in the drill. Do not stop by hand.
9. Adjust table or depth stop to avoid drilling into the table.
10. Select the correct speed, normally slower for metal-faster for wood. The larger the bit, the slower the speed.


BELT GUARD
VARIABLE SPEED PILOT WHEEL
SWITCH
DEPTH STOP
QUILL LOCK
QUILL
KEY CHUCK
TILTING TABLE
LOWER TABLE OR BASE
MOTOR
HEAD SUPPORT SAFETY COLLAR
PILOT WHEEL FEED OR FEED HANDLE
TABLE LOCKING CLAMP
COLUMN
TILT ANGLE LOCKING CLAMP

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Student Competency Sheet

Unit VI: OPERATING AUXILIARY EQUIPMENT AND TOOLS

Module B: Power Tools

Task 3: CUT METAL WITH POWER HACKSAW OR BANDSAW

Performance Checklist

1. Select safety equipment.
2. Select required tools and equipment.
3. Measure and mark metal to be cut.
4. Select and install proper blade.
5. Clamp metal in saw.
6. Set speed and feed control.
7. Cut metal.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Required tools and equipment
4. Piece of metal
5. Metal clamp
6. Measuring instrument
7. Power hacksaw
8. Blades

Task:
1. Measure and mark metal to length specified by your instructor.
2. Cut metal to required length with power hacksaw.

Standard: Metal cut will be ± 3/32" (2mm) of the specified length.

Learning Activities

1. Read:
   a. Machine Tool Technology (McCarthy/Smith), pp. 151-155 and 159-169.
   b. Modern Metalworking (Walker), pp. 35-1 to 35-6.
   c. Welding Principles and Practices (Sacks), pp. 355-357.
2. Observe demonstration by instructor of set up and use of power hacksaw/bandsaw.
3. List in Safety Notebook:
   a. Five (5) personal safety practices.
   b. Five (5) general shop safety practices.
   c. Safety equipment needed.

4. Study Information Sheet VI-B-3 (Horizontal Band Saw), then:

    a. Identify parts on actual model; explain their functions.
    b. Practice setting the saw to cut to specs provided by your instructor.
    c. Identify and practice using safety controls.
    c. Discuss the consequences of errors in measuring, cutting, and saw operation.

5. Under the supervision of your instructor, practice using the power saw.

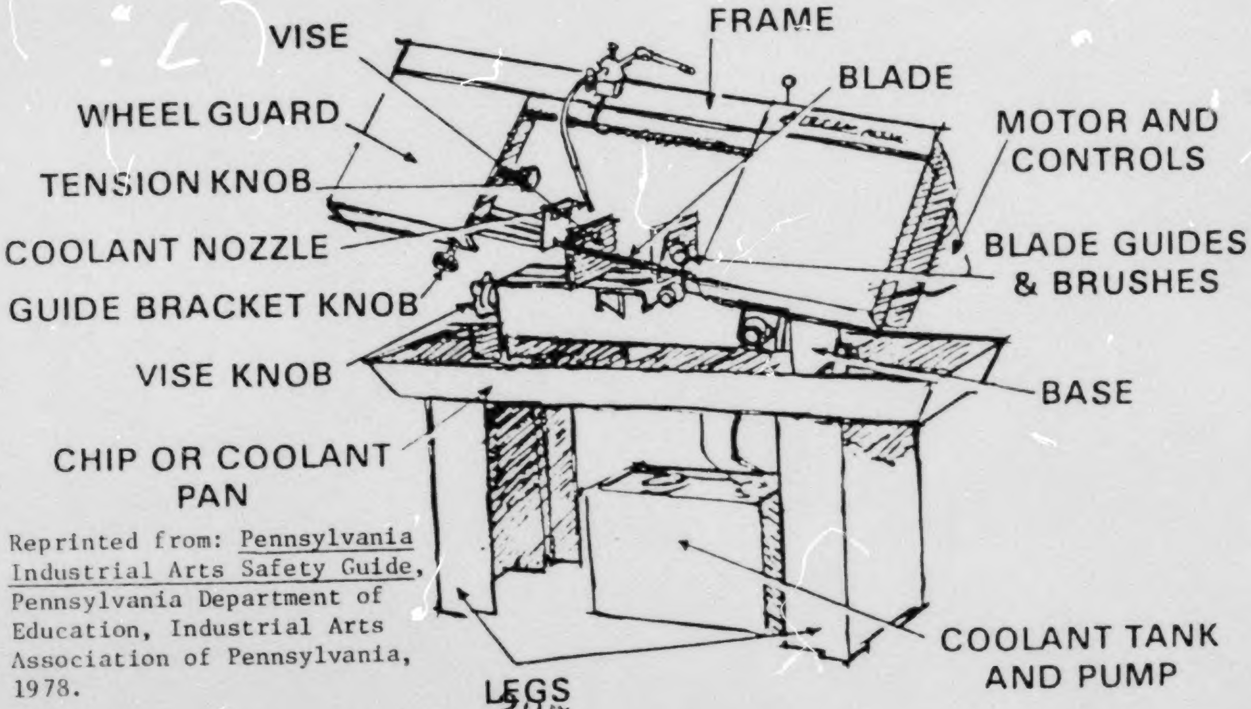
6. Measure and mark metal samples for cutting according to specs provided by your instructor.

7. Obtain work order:

    a. Obtain and lay out material.
    b. Cut on equipment.
    c. Submit finished product to instructor for evaluation.

Information Sheet VI-B-3 -- Horizontal Band Saw

1. **Operate only with instructors permission and after you have received instruction.**
2. **Remove jewelry, eliminate loose clothing, and confine long hair.**
3. **Make sure all guards are in place and operating correctly.**
4. **Always use proper eye protection.**
5. All adjustments to the chip removal brushes, blade tension, guides, vise, or drive system should be done with the power off.
6. Be sure blade guides are properly adjusted to both the blade and the work size or vise before starting cut.
7. Adjust feed rate so blade does not bounce or plunge into work when starting the cut.
8. Be sure work is tightly clamped in the vise and properly positioned for an efficient safe cut.
9. Keep hands away from cutting area and brush away chips only when the machine is turned off.
10. If the material requires coolant be sure the system is working and the correct coolant is used.


FRAME
VISE
BLADE
WHEEL GUARD
MOTOR AND CONTROLS
TENSION KNOB
BLADE GUIDES & BRUSHES
COOLANT NOZZLE
GUIDE BRACKET KNOB
VISE KNOB
BASE
CHIP OR COOLANT PAN
COOLANT TANK AND PUMP
LEGS

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Student Competency Sheet

Unit VI: OPERATING AUXILIARY EQUIPMENT AND TOOLS

Module B: Power Tools

Task 4: GRIND METAL WITH POWER EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Select grinding equipment.
3. Visually inspect condition of equipment for safety.
4. Prepare for grinding.
5. Grind and check as specified.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Grinding equipment
4. Metal
5. American Welding Society Handbook
6. Society of Mechanical Engineers Handbook

Task: Grind metal with selected equipment according to specifications of:
   - a. American Welding Society D1. 1-75, p. 60.
   - b. American Society of Mechanical Engineers, Section IX, p. 4-6-13.

Standard: Metal will be ground for joints as required in the work order specifications.

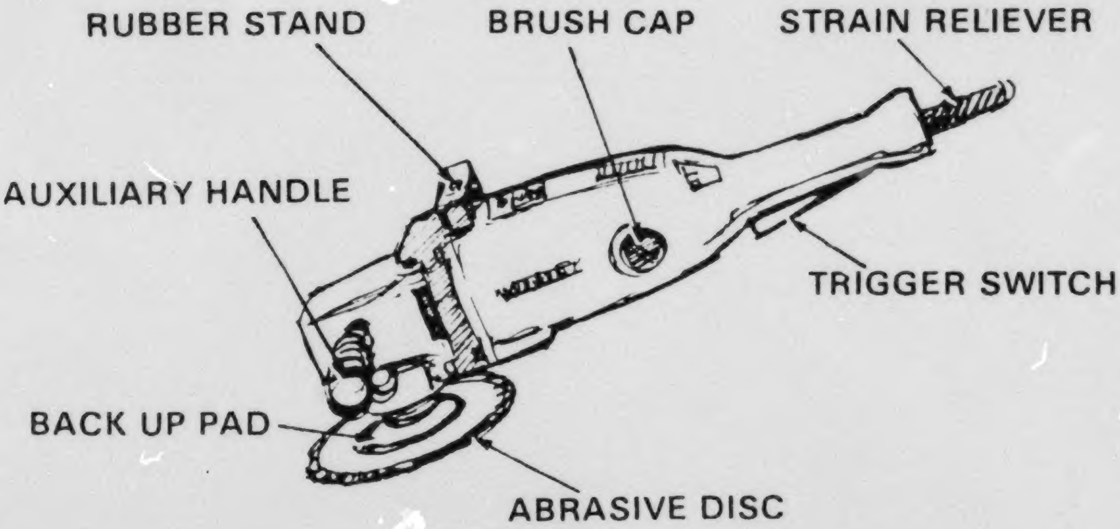
Learning Activities

1. Read:
   - a. Modern Welding (Althouse/Turnquist/Bowditch), pp. 26-12 and 26-13.
   - b. Welding Principles and Practices (Sacks), pp. 350-352.
2. Observe demonstration by instructor of set up and use of:
   - a. Portable electric grinder.
   - b. Portable disc sander.
   - c. Pedestal type grinder.

Information Sheet VI-B-4

Portable Disc Sander

1. **Operate only with instructors permission and after you have received instruction.**
2. **Remove jewelry, eliminate loose clothing, and confine long hair.**
3. **Make sure all guards are in place and operating correctly.**
4. **Always use proper eye protection.**
6. Before connecting to the power source be sure the switch is in the off position.
7. Make sure back up pad and disc are securely fastened to the tool. Unplug the sander when changing discs.
8. Do not allow the edge of the disc to touch the edge of the stock.
9. Stand clear of the spark line or spark area.
10. Sand or finish with a stroking motion; do not pause in one spot.
11. Set grinder on back or on rubber stand when not in use and disconnect from power source.



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3. In Safety Notebook, list five (5) personal and five (5) general shop safety practices for each of the following:

    a. Portable electric grinder
    b. Portable disc sander
    c. Pedestal type grinder

4. Study Information Sheet VI-B-4 (Portable Disc Sander), then:

    a. Identify parts on actual model; explain their functions.
    b. Practice attaching abrasive discs.

5. Study Information Sheet VI-B-4a (Grinder); then:

    a. Identify parts on actual model; explain their functions.
    b. Practice setting up and cleaning the grinder.
    c. Identify and practice using safety devices.
    d. Discuss the consequences of errors in grinding and the grinding operation.

6. Discuss with instructor and class:

    a. Types of grinding wheels and:
        (1) Grits
        (2) Diameters
        (3) Uses
    b. Types of abrasive materials available for disc sander.
    c. Major parts of:
        (1) Portable grinder
        (2) Portable disc sander
        (3) Pedestal grinder

7. Under the supervision of your instructor, practice grinding to specifications using:

    a. Portable grinder
    b. Portable disc grinder
    c. Pedestal grinder

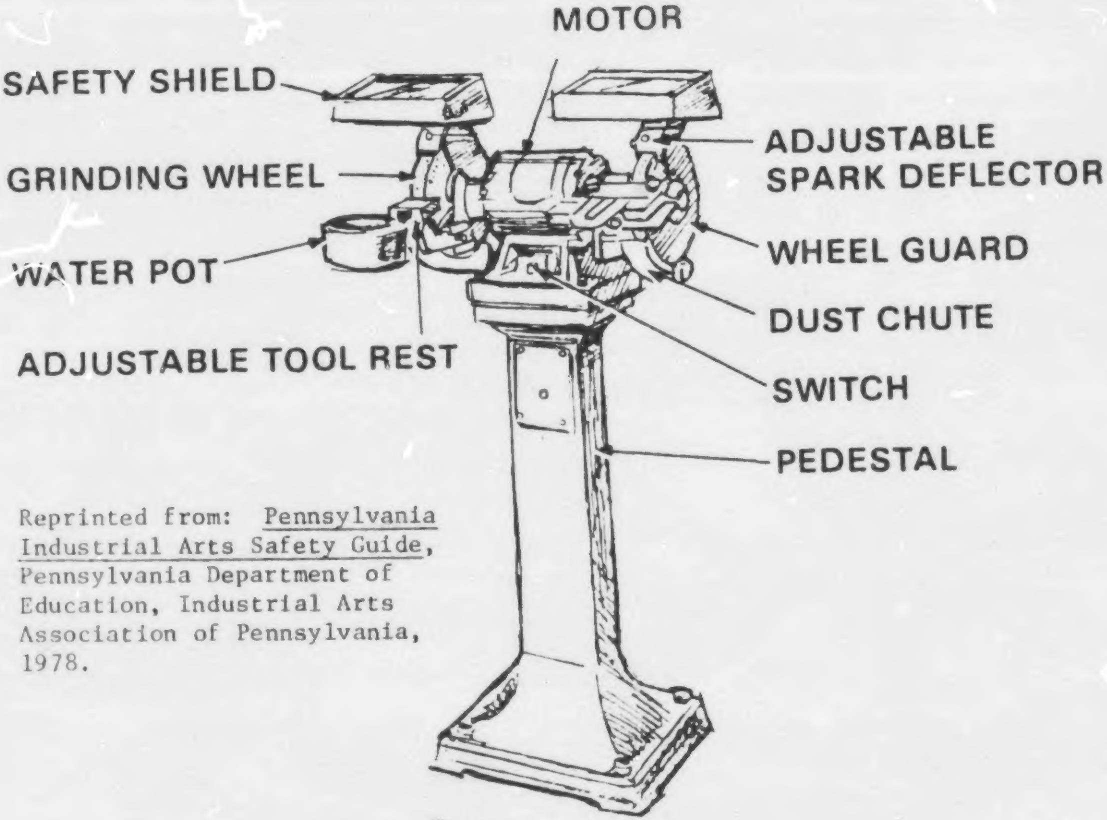
8. Obtain work order from instructor:

    a. Obtain metal.
    b. Obtain proper equipment and safety equipment.
    c. Perform operation specified.
    d. Submit finished project to instructor for evaluation.

9. All items on the Module B Instructor Check Sheet must be completed and approved by the instructor.

Information Sheet VI-B-4 -- Grinder

1. **Operate only with instructors permission and after you have received instruction.**
2. **Remove jewelry, eliminate loose clothing, and confine long hair.**
3. **Make sure all guards are in place and operating correctly.**
4. **Always use proper eye protection.**
5. The tool rests must be adjusted to within 1/16" of the grinding wheel.
6. Spark deflectors must be adjusted to within 1/16" of the grinding wheels.
7. Do not grind on the side of the grinding wheels.
8. Stand to one side when starting the machine.
9. Discard or report grinding wheels that are excessively small or cracked.
10. Small work pieces should be held with "vise grip" type pliers.
11. Do not leave the machine untill the grinding wheels have come to a full stop.


MOTOR
SAFETY SHIELD
GRINDING WHEEL
WATER POT
ADJUSTABLE TOOL REST
ADJUSTABLE SPARK DEFLECTOR
WHEEL GUARD
DUST CHUTE
SWITCH
PEDESTAL

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Unit VI-Module B

INSTRUCTOR CHECK SHEET: Place date activity is completed and approved in Approved column. Rate quality of performance 1 to 4 (1 is poor) in Quality column.

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
1. Hand hacksaw:						
Replacing blades						
Cutting						
2. Chipping hammer.						
3. Finishing metal surfaces with hand tools:						
Files						
Abrasive cloths						
4. Shears - Safety.						
5. Drilling.						
Portable drill:						
Safety						
Operation - (Specify)						
Drill press:						
Safety						
Operation - (Specify)						
6. Power hacksaw:						
Safety						
Changing blades						
Operation - (Specify)						
7. Wire brush:						
Safety procedure						
Operation - (Specify)						
8. Surface grinder - disc type:						
Safety						
Changing disc						
Operation - (Specify)						

Student Competency Sheet

Unit VI: OPERATING AUXILIARY EQUIPMENT AND TOOLS

Module C: Use Rod Oven

Task 1: SET OVEN TEMPERATURE AND STORE ARC ELECTRODES

Performance Checklist

1. Remove from shipping carton.
2. Place in oven.
3. Arrange and separate into different sizes and types.
4. Set oven temperature as required by type and condition of electrodes.

Test

Items Needed:
1. Safety equipment
2. Welding electrodes
3. Oven

Task:
1. Determine correct conditions for electrodes.
2. Store electrodes in oven and set temperature according to code specifications.

Standard: Oven temperature will be set as required by type and condition of electrode, according to American Welding Society, Part B 4.9.2.

Learning Activities

1. Read:
   - a. Modern Welding (Althouse/Turnquist/Bowditch), pp. 6-19 to 6-20.
   - b. Welding Principles and Practices (Sacks), pp. 225-226.
2. Observe demonstration of operating oven by instructor.
3. Send to manufacturers for information concerning their products.
4. List in Safety Notebook:
   - a. Two (2) reasons for using ovens.
   - b. Three (3) safety practices related to ovens.
5. Discuss reasons for oven storage of electrodes and flux.
6. Examine electrodes and flux which have not been stored properly.
7. Set oven temperature and store electrodes and flux according to specifications.

UNIT VII

PERFORMING STRUCTURAL OR EQUIPMENT WELDING AND CUTTING OPERATIONS

Terminal Objectives

Upon completion of the modules in this unit, you will:

- Fabricate or repair tubing systems
- Reconstruct and align frames or related equipment
- Fabricate protective devices for windows and openings
- Fabricate metal reinforcing devices for structural foundations
- Fabricate metal work stands or furniture
- Fabricate or construct storage devices
- Fabricate aluminum structures or devices
- Fabricate corrosion resistant steel
- Prepare and weld pipe joints

Student Competency Sheet

Unit VII: PERFORMING STRUCTURAL OR EQUIPMENT WELDING AND CUTTING OPERATIONS

Module A: Work Order - Applications

Task 1: FABRICATE OR REPAIR TUBING SYSTEMS

Performance Checklist

1. Select safety equipment.
2. Clean, grind, and bevel workpiece as required to patch material.
3. Shape patch material to conform to workpiece.
4. Perform welding operations as specified in work order.
5. Perform leakage and soundness tests.

Test

Items Needed:
1. Work order with sketch
2. Safety equipment
3. Necessary welding equipment
4. Tubing system work piece
5. Necessary equipment and tools
6. Patch material

Task: Fabricate or repair a tubing system as specified in work order.

Standard: Fabrication of the tubing system must be in accordance with tolerances included in the work order.

Learning Activities

1. Read two (2) of the following:
   - a. Modern Welding (Althouse/Turnquist/Bowditch), pp. 18-36, 18-49, and 18-51.
   - b. New Lessons in Arc Welding (Lincoln Electric Company), pp. 1.43 to 1.47.
   - c. Welding Principles and Practices (Sacks), pp. 725-772 and 885-906.
   - d. Welding Technology (Kennedy), pp. 531-562.
2. Read:
   - a. Industrial Welding Procedures (Schell/Matlock), Units 27 and 28, "Butt Welding Pipe."
   - b. Welding Skills and Practices (Giachino/Weeks/Brune), Chapter 33, "Airplane Tubing."

3. Watch a demonstration on patching and testing.

4. Obtain work order from instructor.

    a. Obtain work piece from instructor.
    b. Select safety equipment.
    c. Set up necessary equipment.
    d. Perform weld to specs of work order.
    e. Perform leakage and soundness test.
    f. Submit work piece to instructor for evaluation.

5. Obtain your own work piece.

    a. Determine what needs to be fabricated or repaired and sketch or write specs of how you plan to repair the item.
    b. Submit plan to instructor for approval.
    c. Upon approval, select safety equipment.
    d. Set up equipment.
    e. Perform welding according to instructor-approved plan.
    f. Submit finished project to instructor for evaluation.

Student Competency Sheet

Unit VII: PERFORMING STRUCTURAL OR EQUIPMENT WELDING AND CUTTING OPERATIONS

Module A: Work Order - Applications

Task 2: RECONSTRUCT AND ALIGN FRAMES OR RELATED EQUIPMENT

Performance Checklist

1. Select safety equipment.
2. Prepare workpieces by cutting, grinding, bending, etc., to enable finished product to conform with original contour and dimensions.
3. Align, clamp, and/or tack workpieces.
4. Check alignment to meet work order specifications.
5. Weld joints adding fishplates as required for structural soundness.
6. Clean and check weld joints.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Necessary welding equipment
4. Necessary equipment and materials
5. Metal frame

Task: Reconstruct and align frame as related equipment according to work order specifications.

Standard: The frame must be aligned, repaired, and/or reconstructed to the original dimensions or specifications.

Learning Activities

1. Read:
   a. *Welding Principles and Practices* (Sacks), pp. 19-44.
2. Supplementary Reading:
   a. *Handbook of Arc Welding Design and Practice* (Lincoln Electric Co.), Part 8.
   b. *Electric Arc Welding* (Austin), Chapter 10, "Machinery Welding."
3. Watch a demonstration on frame reconstruction and alignment.

4. Obtain work order from instructor:
    a. Obtain work piece.
    b. Select safety equipment.
    c. Set up necessary equipment.
    d. Perform weld to specs of work order.
    e. Submit project to instructor for evaluation.

5. Obtain your own work project:
    a. Determine what needs to be done;
        (1) Sketch or write procedure you intend to follow.
        (2) Submit plans to instructor for approval.
    b. Select safety equipment.
    c. Set up welding equipment.
    d. Perform weld according to the instructor-approved plan.
    e. Submit finished project to instructor for evaluation of work performed.

Student Competency Sheet

Unit VII: PERFORMING STRUCTURAL OR EQUIPMENT WELDING AND CUTTING OPERATIONS

Module A: Work Order - Applications

Task 3: FABRICATE PROTECTIVE DEVICES FOR WINDOWS AND OPENINGS

Performance Checklist

1. Secure safety equipment.
2. Select stock per project work order.
3. Cut, bend, and grind stock per work order drawing.
4. Align and clamp workpieces.
5. Select correct electrode.
6. Select correct welding machine settings.
7. Perform welding operations.
8. Check project for conformation to work order and sketch.

Test

Items Needed:

1. Work order with sketch
2. Safety equipment
3. Necessary welding equipment
4. Necessary equipment, tools, and materials
5. Metal stock
6. Electrode

Task: Fabricate a protective window devise(s) as specified in the work order.

Standard: Device must conform to specifications included in the work order.

Learning Activities

1. Contact local building inspector for local building code pertaining to window protection restrictions.

2. Read local building code for restrictions.

3. Obtain work order from instructor:

   a. Select safety equipment.
   b. Obtain necessary materials.
   c. Layout, cut, and assemble.
   d. Perform welds to specs of work order.
   e. Submit finished project to instructor for evaluation.

4. Design your own window protection device:
    - a. Submit plans to instructor for approval.
    - b. Obtain materials and safety equipment.
    - c. Fabricate to approved plans.
    - d. Submit finished project to instructor for evaluation.

Student Competency Sheet

Unit VII: PERFORMING STRUCTURAL OR EQUIPMENT WELDING AND CUTTING OPERATIONS

Module A: Work Order - Applications

Task 3: FABRICATE PROTECTIVE DEVICES FOR WINDOWS AND OPENINGS

Performance Checklist

1. Secure safety equipment.
2. Select stock per project work order.
3. Cut, bend, and grind stock per work order drawing.
4. Align and clamp workpieces.
5. Select correct electrode.
6. Select correct welding machine settings.
7. Perform welding operations.
8. Check project for conformation to work order and sketch.

Test

Items Needed:
1. Work order with sketch
2. Safety equipment
3. Necessary welding equipment
4. Necessary equipment, tools, and materials
5. Metal stock
6. Electrode

Task: Fabricate a protective window devise(s) as specified in the work order.

Standard: Device must conform to specifications included in the work order.

Learning Activities

1. Contact local building inspector for local building code pertaining to window protection restrictions.

2. Read local building code for restrictions.

3. Obtain work order from instructor:

   a. Select safety equipment.
   b. Obtain necessary materials.
   c. Layout, cut, and assemble.
   d. Perform welds to specs of work order.
   e. Submit finished project to instructor for evaluation.

4. Design your own window protection device:

   a. Submit plans to instructor for approval.
   b. Obtain materials and safety equipment.
   c. Fabricate to approved plans.
   d. Submit finished project to instructor for evaluation.

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Student Competency Sheet

Unit VII: PERFORMING STRUCTURAL OR EQUIPMENT WELDING AND CUTTING OPERATIONS

Module A: Work Order - Applications

Task 4: FABRICATE METAL REINFORCING DEVICES FOR STRUCTURAL FOUNDATIONS

Performance Checklist

1. Select safety equipment.
2. Select stock per work order.
3. Cut and bend stock per work order.
4. Fabricate workpiece.
5. Clean and check weld joints.

Test

Items Needed:
1. Work order
2. Safety equipment
3. Sketch
4. Metal stock (per work order)
5. Necessary equipment

Task: Fabricate reinforcement device according to work order and sketch.

Standard: Work must meet all requirements of sketch and work order.

Learning Activities

1. Read Masonry Simplified (Dalzell and Townsend), p. 221.

2. Study Federal specifications for metal reinforcement of structural foundations.

3. Read local building code:

    a. Check for requirements.
    b. Note restrictions.

4. Study blueprint specs for reinforcement of concrete foundations. Discuss:

    a. Reinforcement metals.
    b. Reinforcement structures.
    c. Reinforcement welds.

5. Obtain work order from instructor:

   a. Select safety equipment.
   b. Obtain materials.
   c. Fabricate according to work order.
   d. Perform welds to specs of work order.
   e. Submit project to instructor for evaluation.

Student Competency Sheet

Unit VII: PERFORMING STRUCTURAL OR EQUIPMENT WELDING AND CUTTING OPERATIONS

Module A: Work Order - Applications

Task 5: FABRICATE METAL WORK STANDS OR FURNITURE

Performance Checklist

1. Select safety equipment.
2. Select stock per project work order.
3. Cut, bend, and grind stock per work order drawing.
4. Select correct electrode.
5. Select correct welding machine settings.
6. Align, clamp, and tack workpieces.
7. Check workpieces for conformation to work order specifications.
8. Fabricate project by welding as required.
9. Check project.

Test

Items Needed:
1. Work order
2. Sketch
3. Safety equipment
4. Grinding equipment
5. Welding equipment
6. Clamps and fixturing devices
7. Metal work pieces

Task: Fabricate work stands and/or furniture to work order specifications.

Standard: Fabrication must conform to the instructions and specifications in the work order.

Learning Activities

1. Read Electric Arc Welding (Austin), Chapter 1.

2. Study blueprint for a metal TV stand (for example), then:

   a. Discuss materials, welding system, and equipment.
   b. Discuss items to be charged on a bill for materials.
   c. Practice writing a bill for materials, using the blueprint project.

3. Visit local furniture establishments and view metal furniture:

    a. Discuss furniture you saw: structure, quality of work, costs to duplicate.
    b. Sketch a design of at least one (1) piece of furniture you saw; label weld specs.
    c. Discuss your design.

4. Design your own metal project:

    a. Sketch your design and label weld specs.
    b. Develop bill of materials.
    c. Submit plans to instructor.
    d. Fabricate project.
    e. Perform welds to specs.
    f. Submit finished project to instructor for approval.

5. Inspect and discuss your evaluation of the work of at least one (1) classmate:

    a. The design
    b. The weld specifications and welds
    c. The bill of materials
    d. The finished project

Student Competency Sheet

Unit VII: PERFORMING STRUCTURAL OR EQUIPMENT WELDING AND CUTTING OPERATIONS

Module A: Work Order - Applications

Task 6: FABRICATE OR CONSTRUCT STORAGE DEVICES

Performance Checklist

1. Select safety equipment.
2. Select stock per project work order.
3. Cut, bend, and grind stock per work order drawing.
4. Select correct electrode.
5. Select correct welding machine settings.
6. Align, clamp, and tack workpieces.
7. Check workpieces for conformation to work order specifications.
8. Fabricate project by welding as required.
9. Check project.

Test

Items Needed:
1. Work order
2. Sketch
3. Safety equipment
4. Metal work pieces
5. Welding equipment
6. Grinding equipment.
7. Clamps and fixturing devices.

Task: Fabricate storage device to work order specifications.

Standard: Storage device will be fabricated to work order specifications.

Learning Activities

1. Examine storage devices located in shop, home, or industry:
    a. Report designs and welds to the class.
    b. Discuss improvements in design and structure.
2. Develop your own plans (and a bill of materials) for a metal storage device. Device should have practical application.
3. Submit plans to instructor for approval:
    a. Select safety equipment.
    b. Obtain materials.
    c. Fabricate project.
    d. Submit project to instructor for evaluation.

4. Compare your completed project with a similar device in the shop; discuss your evaluation in terms of:

   a. Utility (usefulness and sharpness of design)
   b. Economy
   c. Structural soundness

Student Competency Sheet

Unit VII: PERFORMING STRUCTURAL OR EQUIPMENT WELDING AND CUTTING OPERATIONS

Module B: Work Order - Advanced Applications

Task 1: FABRICATE ALUMINUM STRUCTURES OR DEVICES

Performance Checklist

1. Select safety equipment.
2. Select raw stock per project work order.
3. Mark and cut stock.
4. Bend, assemble, and clamp as required.
5. Set up welding machine.
6. Perform project welding.
7. Check all beads and joints and clean as required.

Test

Items Needed:
1. Work order with sketch
2. Safety equipment
3. Necessary welding equipment
4. Raw aluminum stock
5. Necessary equipment, tools, and materials

Test: Fabricate aluminum structure or device as specified in work order.

Standard: The structure or device must conform to the specifications included in the work order.

Learning Activities

1. Read two (2) of the following:
   a. The Procedure Handbook of Arc Welding (Lincoln Electric Co.), pp. 9.1-1 to 9.4-11.
   b. Welding Principles and Practices (Sacks), pp. 773-818.
   c. Welding Skills and Practices (Giachino/Weeks), pp. 161-188.
2. Supplementary reading:
   a. Welding Alcoa Aluminum (Alcoa), Chapters 1, 2, and 12.
   b. Welding Technology, 2nd Ed. (Giachino/Weeks/Johnson), Chapter 3, "Gas Tungsten-Arc Welding."
   c. New Lessons in Arc Welding (Lincoln Electric Co.) Lesson 2.8.
   d. Metals and How to Weld Them (Jefferson), Chapter 17, pp. 269-278, "Aluminum and Its Alloys."

3. Discuss any points about which you are unsure and/or watch a demonstration by your instructor.

4. Obtain work order from instructor:

    a. Select safety equipment.
    b. Obtain material and lay out according to specs.
    c. Bend, assemble, and clamp.
    d. Set-up welding equipment.
    e. Perform project welding.
    f. Submit for evaluation by instructor.

5. Sketch out project of your own design:

    a. Label sketch with specifications.
    b. Submit completed sketch to instructor for approval.
    c. Obtain material and safety equipment.
    d. Lay out and assemble.
    e. Weld to specs on sketch.
    f. Submit for evaluation by instructor.

6. Inspect and discuss your evaluation of the work of at least one (1) classmate:

    a. The design
    b. The weld specifications and welds
    c. The finished project

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Student Competency Sheet

Unit VII: PERFORMING STRUCTURAL OR EQUIPMENT WELDING AND CUTTING OPERATIONS

Module B: Work Order - Advanced Applications

Task 2: FABRICATE CORROSION RESISTANT STEEL

Performance Checklist

1. Secure safety equipment.
2. Select stock per project work order.
3. Measure, mark, and cut stock to work order specifications.
4. Set up welding equipment.
5. Clamp work pieces and tack.
6. Check alignment of seams.
7. Weld all seams in work piece.
8. Clean joints.

Test

Items Needed:
1. Work order with sketch
2. Safety equipment
3. Necessary welding equipment
4. Necessary equipment and material
5. Corrosion resistant steel stock

Task: Fabricate corrosion resistant steel project according to the work order.

Standard: The project fabrication must meet the specifications in the work order.

Learning Activities

1. Read two (2) of the following:
    a. Industrial Welding Procedures (Schell/Matlock), pp. 149-179.
    b. The Procedure Handbook of Arc Welding (Lincoln Electric Co), pp. 7.1-1 to 7.5-3.
    c. Welding Principles and Practices (Sacks), pp. 847-849 and 775-776.
    d. Welding Skills and Practices (Giachino/Weeks), pp. 141-147, 186-187, 205, 224-225, and 278-279.
2. Supplementary reading:
    a. Welding Technology, 2nd Ed. (Giachino/Weeks/Johnson), p. 83, Table 1.
    b. Metals and How to Weld Them (Jefferson), Chapters 15, 16, and 17.

3. Discuss any points about which you are unsure and/or watch a demonstration by your instructor.

4. Obtain work order from instructor:

   a. Obtain material specified.
   b. Select safety equipment.
   c. Layout material and assemble to specs.
   d. Set up welding equipment needed.
   e. Perform welding operation.
   f. Submit finished project to instructor for evaluation.

5. Lay out a project of your own design:

   a. Submit plans to instructor for approval.
   b. Obtain material necessary.
   c. Selected safety equipment.
   d. Fabricate project.
   e. Weld to your approved specs.
   f. Submit finished project to instructor for evaluation.

6. Inspect and discuss your evaluation of the work of at least one (1) classmate:

   a. The design.
   b. The weld specifications and welds.
   c. The finished project.

Student Competency Sheet

Unit VII: PERFORMING STRUCTURAL OR EQUIPMENT WELDING AND CUTTING OPERATIONS

Module B: Work Order - Advanced Applications

Task 3: PREPARE AND WELD PIPE JOINTS

Performance Checklist

1. Select safety equipment.
2. Select proper tools and equipment.
3. Check specifications for particular code.
4. Set up and regulate cutting equipment.
5. Cut pipe.
6. Bevel pipe to specifications.
7. Grind or turn in lathe as required.
8. Tack weld as per code specifications.
9. Set up and adjust arc welding equipment.
10. Select electrode of filler wire.
11. Set for purge if necessary.
12. Weld to code specifications.

Test

Items Needed:

1. Work order
2. Safety equipment
3. Necessary equipment
4. Arc welding equipment
5. Metal pipe
6. Lathe
7. Electrode of filler wire
8. American Welding Society Handbook
9. American Petroleum Society Handbook
10. American Society of Welding Engineers Handbook

Task:

1. Cut, set up, fit, tack, and weld pipe joint to code specifications in the following positions:
   a. 2G b. 5G c. 6G
2. Pipe welding, in each of the above positions, must be performed using each of the following processes:
   a. SMAW b. GTAW c. GMAW

Standard: Work must conform to standards in one (1) of the following:

1. American Welding Society, D-10. 9-69
2. American Petroleum Society Handbook
3. American Society of Mechanical Engineers, Section IX, p. 4-5-2, QW-452.3

Learning Activities

1. Read two (2) of the following:
    - a. The Procedure Handbook of Arc Welding (Lincoln Electric Co.), pp. 11.3-35 to 11.3-38, and 13.3-1 to 13.3-9.
    - b. Welding Principles and Practices (Sacks), pp. 725-772, 801-818, and 885-906.
    - c. Welding Skills and Practices (Giachino/Weeks), pp. 324-335.
2. Supplementary reading:
    - a. New Lessons in Arc Welding (Lincoln Electric Co.), 1.43 through 1.47.
    - b. Electric Arc Welding (Austin), Chapter 8, "Pipe Welding."
3. Observe demonstrations by your instructor on preparing and welding pipe joints:
    - a. Take notes in Safety Notebook.
    - b. Discuss code requirements
    - c. Discuss skill requirements for local industries.
4. Practice preparing and welding pipe joints in 2G, 5G, and 6G positions, using each of the following processes:
    - a. SMAW
    - b. GTAW
    - c. GMAW
5. Obtain work order from instructor:
    - a. Select safety equipment.
    - b. Materials specified.
    - c. Set up equipment.
    - d. Perform tasks specified.
    - e. Submit finished projects to instructor.
6. Inspect and discuss your evaluation of the work of at least one (1) classmate.
7. All items on the Module B Instructor Check Sheet must be completed and approved by the instructor.

Unit VII-Module B

INSTRUCTOR CHECK SHEET: Place date activity is completed and approved in Approved column. Rate quality of performance 1 to 4 (1 is poor) in Quality column.

	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
1. Fabricate aluminum structor. Give description:________ ________________						
2. Fabricate tubing system. Give description:________ ________________						
3. Reconstruct or align frames. Give description:________ ________________						
4. Fabricate corrosion resistant steel. Give description: ________________ ________________						
5. Fabricate protective devices for windows or opening. Give description:________ ________________						
6. Fabricate metal reinforcing devices for structural foundations.						
7. Fabricate metal work stand or furniture.						
8. Fabricate storage devices.						
9. Prepare and weld pipe joints						
10. Cut metal using mapp or propane type gas.						

UNIT VIII

WELDER CERTIFICATION TEST

Terminal Objectives

Upon completion of the modules in this unit, you will have prepared to take the welder certification test(s). Specifically, you will have:

- Prepared for the test(s)
- Practiced and become proficient in tasks performed for the plate test
- Practiced and become proficient in tasks performed for the pipe test

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Student Competency Sheet

Unit VIII: WELDER CERTIFICATION TEST

Module A: Procedure

Task 1: PREPARATION FOR TESTING

Performance Checklist

1. Attain a satisfactory rating from your instructor in all areas to be tested. Satisfactory completion of a welding program approved by the West Virginia Departments of Labor and Education is required.
2. Study test requirements and stipulations.
3. Select type of test to be attempted (plate or pipe).
4. Identify approved test sites in the State.
5. Obtain application and permission to take test from your instructor.
6. Submit application.
7. Verify date of test.
8. Take test.

Test

Items Needed:
1. Evidence of satisfactory completion of a welding program (diploma or certificate).
2. Information on State of West Virginia "Welder Certification Test Procedure"
3. Application for testing
4. Evidence of approval for testing (from instructor or other testing agent)

Task: Prepare to be tested for welding certification.

Standard:
1. Applicant must be adjudged by instructor to have attained satisfactory performance in all competencies required to achieve an acceptable testing demonstration.
2. Application for testing must be correctly written and processed.

Learning Activities

1. Read Information Sheet VIII-A-1.

2. Discuss with your instructor, a classmate, or a practicing welder the reasons for, and importance of, welding certification.

3. Attend a lecture by your instructor about:

   a. Type of welding certification required in various industries.
   b. Type of welding certification required to work in local shops or companies.

4. Research, in the shop or school library, the requirements for certification in other states (Maryland, Pennsylvania, Ohio, Kentucky, Virginia, Tennessee). Test yourself: Could you meet these requirements? Identify competencies you would need to develop to do so.

5. Practice completing an application to take the welding certification test.

6. Discuss with your instructor any portions of Information Sheet VIII-A-1 which you do not understand completely.

Information Sheet VIII-A-1

State of West Virginia
WELDER CERTIFICATION TEST PROCEDURE

BASIC INFORMATION*

INTENT

The State of West Virginia Welder Performance Certification test, as described herein, is intended to demonstrate the ability of a welder to make sound welds. It is the desire of the West Virginia Departments of Labor and Education to provide any resident citizen a location, equipment, and supervision whereby his ability may be tested in uniform fairness, regardless of test location. A certificate will be issued by the Department of Labor for each test completed within the scope of this procedure.

TEST SITE

1. The State of West Virginia welding certification test may be conducted at any school operating under the Department of Education and duly certified by the Department of Labor.
2. The Department of Labor, upon inspection of an approved test site and finding discrepancies either with equipment or test procedure, may either place on probation or revoke site approval.
3. The Department of Education shall be advised and concur before any action concerning the site revocation is issued.

RESPONSIBILITY

1. It shall be the responsibility of the welding instructor to supervise all aspects of the welding test as described in this procedure (Tasks 1, 2, and 3 of this module).
2. The failure of the welding instructor to properly conduct a test may cause its rejection and loss of certification of his school to conduct the test.

BASIC TEST STIPULATIONS

Test:

A welding test shall include:
1. Stamping of test plates with identification.
2. Welding of test plates in all required positions.
3. Properly removing coupons from the test plates and preparing them for bending.
4. Bending of test plates.

BASIC TEST STIPULATIONS (Continued)

Test Type:

1. The type of test may be plate or pipe.
2. The welder may complete a test of each type; however, the pipe test in all positions also qualifies welding of plate in all positions, thereby eliminating the need of the plate test when the pipe test is completed first.

Welding Process:

1. The welding process used may be any standard welding process.
2. No more than one (1) process may be used in one (1) test; however, the welder may complete a certification test using each process.
3. The welder may also complete both types of tests (pipe and plate) with each change or process.

Metals:

1. Base Metal
    a. The base metal (test pieces or plate) shall be of mild steel material.
    b. The welding instructor is not hereby restricted in conducting tests prescribed by himself using other materials.
2. Filler Metal
    a. The chemical composition of the test filler metal shall not exceed 6% alloy.
    b. Use of more than one (1) grade of filler metal in one (1) weld groove or one (1) test is not permitted.
    c. A range of electrode size from 3/32" to 3/16" may be used.
    d. When low hydrogen electrodes are used, they must be kept in properly heated storage after removal from containers.

Backing:

No backing at the root of the weld is permitted, except that a gas purge may be employed when the gas metal arc process is used.

Weld Groove Design:

1. The weld groove design shall be the single V-type.
2. When flame cutting is used to bevel test pieces, the riffles produced by this process shall be ground or milled to remove all carburized metal.
3. Dimensions of the test groove will be as shown in Figure 1.

BASIC TEST STIPULATIONS (Continued)

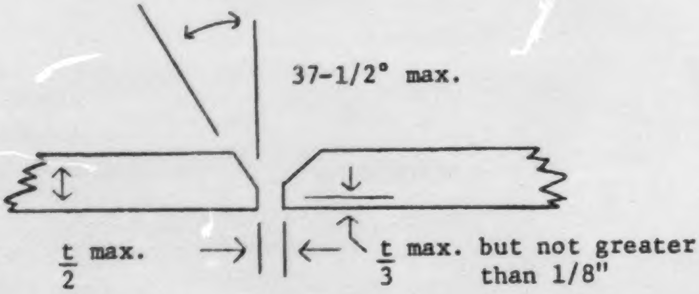

Figure 1
Weld Groove Design

DISQUALIFICATION

1. Any welder who does not follow the rules of the procedure prescribed may be disqualified by the welding instructor or Department of Labor Inspector.
2. When disqualification occurs, re-test may or may not be allowed by the welding instructor or Department of Labor Instructor.

TEST RECORDS

1. The welding instructor shall supervise each test.
2. The welding instructor shall maintain records to ascertain if each welder conducts his/her test or re-test to the prescribed procedure.
3. The welding instructor shall have the responsibility and authority to grade any test, reject any coupon, or disqualify any welder.
4. Any coupon not acceptable to the welding instructor shall also not be acceptable to the Department of Labor Inspector; however,
5. The Department of Labor Inspector shall make the final decision on any test coupons he reviews for acceptance.
6. After completion of each test and/or re-test, the welding instructor shall complete in detail a welder certification test report.
7. The welding inspector shall send the test report to the Department of Labor within five (5) days of the test completion date.
8. The weld test coupons shall be kept in locked storage for a period of sixty (60) days, after which they shall be destroyed or disposed of by other suitable means.

TEST SITE REVIEW

Welder test sites are subject to review by Department of Labor Inspectors for the purpose of reviewing welder test coupons and to monitor test procedures.

CERTIFICATE

1. A State of West Virginia Welding Certificate will be issued by the Department of Labor and signed by the Commissioner for each weld test conducted and accepted within the scope of the prescribed procedure.
2. Each certificate shall be considered valid until such time the person so named on the certificate does not weld in the stated purposes for a period of one (1) year.
3. The employer may, at any time, require a re-test of his employee when that employee's ability to make sound welds is questionable.

DEPARTMENT OF LABOR RECORDS

1. The Department of Labor will keep the welder certificate test report on file for a period of one (1) year from which a duplicate certificate may be issued upon written request by the welder.
2. Any welder desiring a West Virginia Welding Certificate after that time must conduct a re-test.

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*NOTE: This procedure may change, pending approval of the West Virginia Departments of Labor and Education.

Student Competency Sheet

Unit VIII: WELDER CERTIFICATION TEST

Module A: Procedure

Task 2: PLATE TEST

Performance Checklist

1. Set up welding equipment.
2. Prepare or procure test pieces from instructor.
3. Fit up test pieces.
4. Join test pieces with tack welds.
5. Metal stamp each test plate to identify each coupon.
6. Weld a test plate in the horizontal position.
7. Weld a test plate in the vertical position.
8. Weld a test plate in the overhead position.
9. Remove test plate for cleaning of slag or grinding.
10. Grind or clean test plates.
11. Return test plate to proper position for continued welding, as necessary.
12. Remove two (2) test coupons from each test plate (horizontal, vertical, and overhead). Test coupons must be removed from each test plate transverse to weld groove.
13. Grind or file test coupons to remove excess weld (reinforcement).
14. Remove corners of coupon to a 1/8" radius to eliminate the high stress edge area.
15. Grease test coupon or test jig rolls, if desired.
16. Bend all test coupons, or procure bent coupons from instructor. (One (1) face bend and one (1) root bend are required for each weld position.)

Test

Items Needed:
1. Standard welding equipment
2. Six (6) base metal (mild steel material) test pieces, minimum size 3/8" x 4" x 4" (two (2) test pieces tack welded or welded together = one (1) test plate)
3. Filler metal of 6% alloy (maximum)
4. Electrode: 3/32" to 3/16" range

CAUTION: Hydrogen electrodes, if selected, must be kept in properly heated storage after removal from container.

NOTE: Backing is not permitted at the root of the weld, except that a gas purge may be employed when the gas metal arc process is used.

Task: Weld test plates in the following positions:

1. Horizontal position
2. Vertical position
3. Overhead position

Standard:

1. Prior to bending:
   - a. The base material thickness shall not have been reduced by the process of weld reinforcement removal.
   - b. There shall be no evidence of lack of fusion at the weld.
   - c. There shall be no evidence of lack of penetration at the weld.
   - d. There shall be no evidence of undercut in or at the weld.
2. After bending:
   - a. The guided bend specimen (coupon) shall have no open defect exceeding 3/32" or aggregate defects in excess of 1/8" measured in any direction on the convex surface of the specimen.
   - b. Cracks occurring on the corners of the test specimen shall not be considered unless there is definite evidence that they result from slag or other internal defects.
3. All coupons must be rated by the test supervisor (welding instructor) and the Department of Labor Inspector.

Learning Activities

1. Read Information Sheet VIII-A-2.

2. Observe a demonstration of the procedure. Discuss the demonstration with your instructor and classmates.

3. Select the base metal and filler metals you plan to use for the test. Justify your selection to your instructor, based upon your past skill performance, processes (equipment) available to you, and your occupational goals.

4. Practice the procedure, using two (2) types of standard welding equipment.

5. Explain the procedure and the requirements for acceptable performance to a classmate. Point out, on examples, unacceptable flaws.

6. Demonstrate the procedure to your instructor, using the standard welding equipment you wish to use to take the test.

Information Sheet VIII-A-1

State of West Virginia
WELDER CERTIFICATION TEST

PLATE TEST*

PLATE TEST PIECES

1. The welder may prepare or be provided with test pieces.
2. Test pieces of plate material shall be a minimum size of 3/8" x 4" x 4".
3. A total of six (6) test pieces is necessary for one (1) test, except this number will vary for a required re-test.

TEST PLATE

1. Two (2) test pieces tack welded or welded together will constitute a test plate.
2. The welder must make the fit up of test pieces as described in Figure 1. The pieces must be joined with tack welds. (Tack welds may be made in the down flat position.)

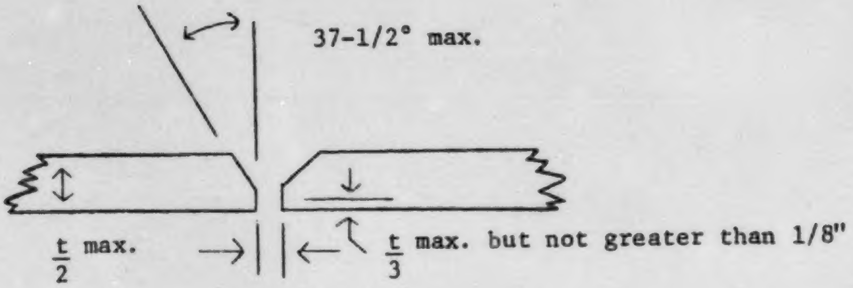


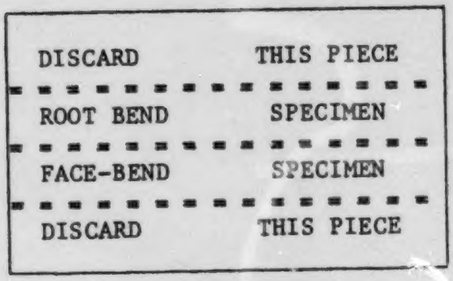
Figure 1 - Weld Groove Design

TEST COUPON

1. A test coupon is a rectangular segment removed from the test plate transverse to the weld groove.
2. Each test coupon shall be a minimum of 1-1/2" in width after removal from the test plate.

TEST PLATE IDENTIFICATION

1. Each test plate shall be metal stamped to identify each coupon, as shown in Figure 2.
2. The stamping will include:
   - a. The welder's initials.
   - b. The welding process, which will be identified by stamping each coupon with one (1) of the following:
     - (1) OA for oxyacetylene
     - (2) MA for shielded metal arc
     - (3) MIG or TIG, as it may apply for gas metal arc
   - c. The weld position:
     - (1) H for horizontal
     - (2) V for vertical
     - (3) O for overhead



Identification Stamping:

Welder's Initials
Welding Process Symbol
Weld Position Symbol

Figure 2 - Test Plate Layout

Test coupons will be removed as shown above for horizontal, vertical, and overhead test positions

TEST POSITIONS

The plate test shall include welding of test plates in the three (3) following positions:

1. Horizontal - Plate placed in a vertical plane ± 5° with the axis of weld groove horizontal ± 5° (Figure 3A)

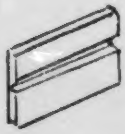


Figure 3A - Horizontal

TEST POSITIONS (Continued)

2. Vertical - Plate placed in a vertical plane ± 5° with the axis of weld groove vertical ± 5° (Figure 3B)

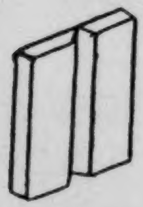


Figure 3B - Vertical

3. Overhead - Plate placed on a horizontal plane ± 5° with the axis of the weld groove horizontal ± 5° and the filler metal deposited from the underside. (Figure 3C)

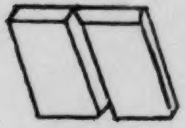


Figure 3C - Overhead

GRINDING

1. The test plate may be removed from position for cleaning of slag or grinding.
2. If removed for cleaning or grinding, the test plate shall be returned to proper position for continued welding.
3. A grinder may be employed to remove slag inclusions and tack welds if desired during progression of welding.

UNACCEPTABLE CONDITIONS

1. Welding Undercut
    a. Undercut is a groove melted into the base metal adjacent to the toe of a weld and left unfilled by weld metal.
    b. Undercut may be found within the weld groove or on a surface at the edge of the cover pass.
2. Lack of Penetration
    a. Lack of penetration is the failure to completely fill the weld groove, or
    b. Lack of penetration is the absence of weld metal at the root of the weld.
3. Lack of Fusion
    a. Lack of fusion is the lack of coalescence between the base and weld metals.

TIME SPAN AND SEQUENCE

1. The welder shall prepare or be provided with one set of test plates.
2. A maximum time of three (3) days shall be allotted to complete the plate test.
3. The starting time shall be after required pieces are made ready for welding the root pass.
4. The completion time will be when all test coupons have been accepted by the instructor.
5. Test plates may be welded in succession or coupons may be removed and bent after each test plate is completed (whichever is preferred by the instructor).

TEST COUPONS REQUIRED

1. Two (2) test coupons shall be removed from each test plate.
2. A total of six (6) coupons shall be removed from the complete plate test.

PREPARATION OF COUPONS

1. The coupons shall be timely removed and prepared for bending, as described above.
2. Excess weld (reinforcement) shall be removed by grinding and filing.
3. The welded area shall be finished flush or nearly flush to the plane of the plate material.
4. Rough grind marks will be removed, and the edges of the weld will be made visible.
5. The corners of the coupon may be removed to a 1/8" radius to eliminate the high stress edge area.

BENDING OF COUPONS

1. The welding instructor shall bend or witness bending of all test coupons.
2. One (1) face bend and one (1) root bend is required for each weld position (test plate).
3. The weld and heat affected zone shall be within the bend.
4. The coupon shall be bent to a true U-shape or as near to a U-shape so as not to allow a 1/8" space between the test jig plunger and the test coupon.
5. The test coupon or test jig rolls may be greased to minimize drag.

ACCEPTANCE CRITERIA

1. Prior to bending, the base material thickness shall not have been reduced by the process of weld reinforcement removal.
2. There shall be no evidence of lack of fusion, lack of penetration, or undercut in or at the weld.

ACCEPTANCE CRITERIA (Continued)

3. After bending, the guided bend specimen (coupon) shall have no open defect exceeding 3/32" or aggregate defects in excess of 1/8" measured in any direction on the convex surface of the specimen after bending.
4. Cracks occurring on the corners of the test specimen shall not be considered unless there is definite evidence that they result from slag or other internal defects.
5. Failure of one (1) coupon of a test position constitutes failure of that position.

RE-TEST

1. An immediate re-test may be made for any one (1) position failed, provided the welder completes two (2) consecutive test plates in that position.
2. The two (2) test plates shall be prepared and completed so as to produce four (4) coupons:
   a. Two (2) must be face bends.
   b. Two (2) must be root bends.
3. The welding procedure to be followed for the re-test shall be the same as in the original test, except that the letter indicating the position shall be preceded by the letter "R" to indicate a re-test.
4. Failure of one (1) or more re-test coupons shall constitute failure of a re-test.
5. One (1) day will be the allotted time for re-test.
6. Should the welder fail more than one position of a test or re-test, he/she must undergo a period of practice or additional training, after which he/she may duplicate the original test.
   (NOTE: The practice or training period required shall be the decision of the welding instructor.)

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*NOTE: This procedure may change, pending approval of the West Virginia Departments of Labor and Education.

Student Competency Sheet

Unit VIII: WELDER CERTIFICATION TEST

Module A: Procedure

Task 3: PIPE TEST

Performance Checklist

1. Set up welding equipment.
2. Prepare or procure test pieces from instructor.
3. Fit test pieces.
4. Secure test pieces to prevent rotation.
5. Weld a test plate in the horizontal position.
6. Weld a test plate in the vertical position.
7. Metal stamp each test plate to identify each coupon.
8. Remove test plate for cleaning of slag or grinding.
9. Grind or clean test plates.
10. Return test plate to proper position for continued welding, as necessary.
11. Remove two (2) test coupons from the horizontal pipe test plate.
12. Remove four (4) coupons from the vertical pipe test plate.

(NOTE: All six (6) test coupons must be removed transverse to weld groove.)

13. Grind or file test coupons to remove excess weld (reinforcement).
14. Remove corners of coupon to a 1/8" radius to eliminate the high stress edge area.
15. Grease test coupon or test jig rolls, if desired.
16. Bend all test coupons, or procure bent coupons from instructor. (Two (2) face bends and two (2) root bends from the vertical pipe test plate are required. One (1) face bend and one (1) root bend is required from the horizontal pipe test plate.)

Test

Items Needed:

1. Standard welding equipment
2. Four (4) pipe test pieces of base metal (mild steel material)
   a. Test pieces of pipe shall have an outside diameter of four (4) to seven (7) inches.
   b. The wall thickness may be 5/16" to 7/16"
   c. The length of each piece shall be a minimum of four (4) inches.
3. Filler metal of 6% alloy (maximum)
4. Electrode: 3/32" to 3/16" range

CAUTION: Hydrogen electrodes, if selected, must be kept in properly heated storage after removal from container.

NOTE: Backing is not permitted at the root of the weld, except that a gas purge may be employed when the gas metal arc process is used.

Task: Weld pipe test pieces in the following positions:

1. Horizontal position
2. Vertical position

Standard:

1. Prior to bending:
   a. The base material thickness shall not have been reduced by the process of weld reinforcement removal.
   b. There shall be no evidence of lack of fusion at the weld.
   c. There shall be no evidence of lack of penetration at the weld.
   d. There shall be no evidence of undercut in or at the weld.
2. After bending:
   a. The guided bend specimen (coupon) shall have no open defect exceeding 3/32" or aggregate defects in excess of 1/8" measured in any direction on the convex surface of the specimen.
   b. Cracks occurring on the corners of the test specimen shall not be considered unless there is definite evidence that they result from slag or other internal defects.
   c. All coupons must be rated acceptable by the test supervisor (welding instructor) and the Department of Labor Inspector.

Learning Activities

1. Read Information Sheet VIII-A-3.

2. Observe a demonstration of the procedure. Discuss the demonstration with your instructor and classmates.

3. Select the base metal and filler metal you plan to use for the test. Justify your selection to your instructor, based upon your past skill performance, processes (equipment) available to you, and your occupational goals.

4. Practice the procedure, using two (2) types of standard welding equipment.

5. Explain the procedure and the requirements for acceptable performance to a classmate. Point out, on examples, unacceptable flaws.

6. Demonstrate the procedure to your instructor, using the standard welding equipment you wish to use to take the test.

Information Sheet VIII-A-3

State of West Virginia
WELDER CERTIFICATION TEST

PIPE TEST*

PIPE TEST PIECES

1. The welder may prepare or be provided with pipe test pieces.
2. Test pieces of pipe shall have an outside diameter of four to seven inches.
3. The wall thickness may be 5/16" to 7/16"
4. The length of each piece of pipe shall be a minimum of four inches.
5. A total of four pieces is needed for the test, except in the case of re-test.

TEST PLATE

1. Two (2) test pieces tack welded or welded together will constitute a test plate.
2. The welder must make the fit up of test pieces as described in Figure 1. The pieces must be joined with tack welds. (Tack welds may be made in the down flat position).

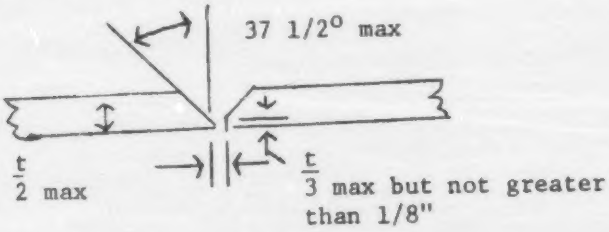

Figure 1 - Weld Groove Design

TEST COUPON

1. A test coupon is a rectangular segment removed from the test plate transverse to the weld groove.
2. Each test coupon shall be a minimum of 1-1/2" in width after removal from the test plate.

TEST PLATE IDENTIFICATION

1. Each test plate shall be metal stamped to identify each coupon, as shown in Figure 2.
2. The stamping will include:
   a. The welder's initials.
   b. The welding process, which will be identified by stamping each coupon with one of the following:
      (1) OA for oxyacetylene
      (2) MA for shielded metal arc
      (3) MIG or TIG, as it may apply for gas metal arc

TEST PLATE IDENTIFICATION (Continued)

c. The weld position:
   (1) H for horizontal
   (2) V for vertical. The vertical pipe position test plate shall be stamped "TOP" and this stamping shall remain on top during welding.

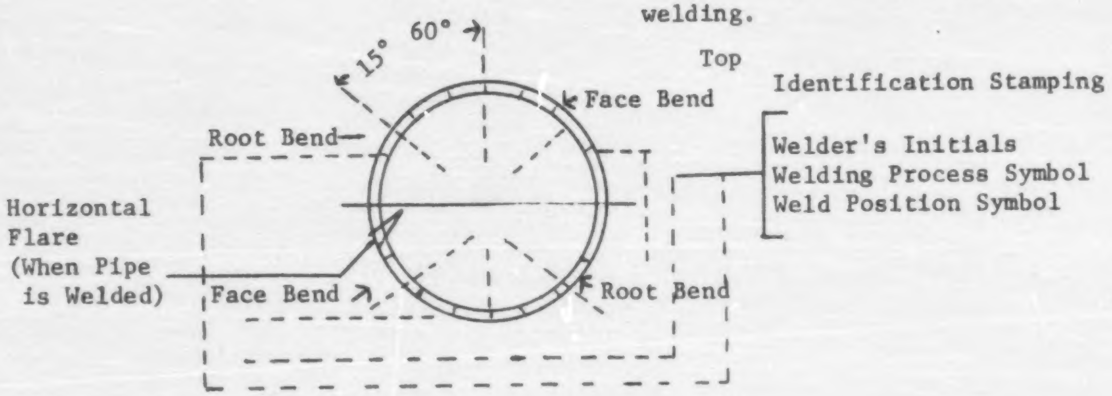
15°
60°
Top
Face Bend
Identification Stamping
Root Bend
Welder's Initials
Welding Process Symbol
Weld Position Symbol
Horizontal Flare (When Pipe is Welded)
Face Bend
Root Bend

Figure 2
Vertical Pipe Position

NOTE: Two coupons shall be removed opposite each other from any location on the horizontal test.

Four coupons shall be removed from locations as shown above for vertical position test.

TEST POSITIONS

The pipe test shall include welding of test plates in the two following positions:

1. Horizontal: Pipe placed with its axis vertical and the axis of the weld groove in a horizontal plane. The pipe shall not be rotated during welding. (Figure 3A)

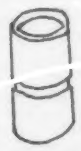

Figure 3A
Horizontal Position

TEST POSITIONS (Continued)

2. Vertical: Pipe placed with its axis horizontal and the weld groove in a vertical plane. Weld metal shall be deposited without rotating the pipe. (Figure 3B)

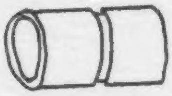

Figure 3B
Vertical Position

NOTE: The single 45° position pipe test is not permitted.

GRINDING

1. The test plate may be removed from position for cleaning of slag or grinding.
2. If removed for cleaning or grinding, the test plate shall be returned to proper position for continued welding.
3. A grinder may be employed to remove slag inclusions and tack welds if desired during progression of welding.

UNACCEPTABLE CONDITIONS

1. Welding Undercut
    a. Undercut is a groove melted into the base metal adjacent to the toe of a weld and left unfilled by weld metal.
    b. Undercut may be found within the weld groove or on a surface at the edge of the cover pass.

2. Lack of Penetration
    a. Lack of penetration is the failure to completely fill the weld groove, or
    b. Lack of penetration is the absence of weld metal at the root of the weld.

3. Lack of Fusion
    a. Lack of fusion is the lack of coalescence between the base and weld metals.

TIME SPAN AND SEQUENCE

1. The welder shall prepare or be provided with one set of test plates.
2. A maximum time of two days shall be allotted to complete the pipe test.
3. The starting time shall be after required pieces are made ready for welding the root pass.
4. The completion time will be when all test coupons have been accepted by the instructor.

TIME SPAN AND SEQUENCE (Continued)

5. Test plates may be welded in succession or coupons may be removed and bent after each test plate is completed (whichever is preferred by the instructor).

TEST COUPONS REQUIRED

1. Two test coupons shall be removed from the horizontal pipe test plate.
2. Four coupons shall be removed from the vertical pipe test plate. (A total of six coupons shall be removed for the complete test.)
3. The welder may remove the coupons by sawing or flame cutting.
4. Care should be taken to incorporate the identification stampings on each coupon. (Figure 2)

PREPARATION OF COUPONS

1. The coupons shall be timely removed and prepared for bending, as described above.
2. Excess weld (reinforcement) shall be removed by grinding and filing.
3. The welded area shall be finished flush or nearly flush to the plane of the plate material.
4. Rough grind marks will be removed, and the edges of the weld will be made visible.
5. The corners of the coupon may be removed to a 1/8" radius to eliminate the high stress edge area.

BENDING OF COUPONS

1. The welding instructor shall bend or witness bending of all test coupons.
2. One face bend and one root bend is required from the horizontal pipe test plate.
3. Two face bends and two root bends are required from the vertical pipe test plate.
4. The weld and heat affected zone shall be within the bend.
5. The coupon shall be bent to a true U shape or as near to a U shape so as not to allow a 1/8" space between the test jig plunger and the test coupon.
6. The test coupon or test jig rolls may be greased to minimize drag.

ACCEPTANCE CRITERIA

1. Prior to bending, the base material thickness shall not have been reduced by the process of weld reinforcement removal.
2. There shall be no evidence of lack of fusion, lack of penetration, or undercut in or at the weld.

ACCEPTANCE CRITERIA (Continued)

3. After bending, the guided bend specimen (coupon) shall have no open defect exceeding 3/32" or aggregate defects in excess of 1/8" measured in any direction on the convex surface of the specimen after bending.
4. Cracks occurring on the corners of the test specimen shall not be considered unless there is definite evidence that they result from slag or other internal defects.
5. Failure of one coupon of a test position constitutes failure of that position.

RE-TEST

1. An immediate re-test may be made for any one position failed, provided the welder completes two consecutive test plates in that position.
2. The two test plates shall be prepared and completed so as to produce four coupons:
   a. Two must be face bends.
   b. Two must be root bends.
3. The welding procedure to be followed for the re-test shall be the same as in the original test, except that the letter indicating the position shall be preceded by the letter "R" to indicate a re-test.
4. Failure of one or more re-test coupons shall constitute failure of the re-test.
5. One day will be allotted time for re-test.
6. Should the welder fail more than one position of a test or re-test, he/she must undergo a period of practice or additional training, after which he/she may duplicate the original test. (Note: The practice or training period required shall be the decision of the welding instructor.)

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*NOTE: This procedure may change, pending approval of the West Virginia Departments of Labor and Education.

UNIT IX

SUPERVISION, TRAINING AND JOB ESTIMATING

Terminal Objectives

Upon completion of the modules in this unit, you will have had experience which will enable you to:

- Estimate labor and materials costs of new fabrication
- Estimate costs of repairs
- Write performance standards for jobs
- Plan and conduct on-the-job training for employees
- Conduct oral safety briefings
- Improve work methods
- Plan and schedule work assignments
- Assign work to others
- Prepare an annual shop budget
- Receive and record a new shipment of supplies
- Interview job applicants
- Prepare an accident report

Student Competency Sheet

Unit IX: SUPERVISION, TRAINING, AND JOB ESTIMATING

Module A: Job Estimating

Task 1: ESTIMATE LABOR AND MATERIAL COSTS OF NEW FABRICATION

Performance Checklist

1. Check blueprint for type and sizes of material required.
2. Prepare a materials list.
3. Using catalog and sample price list estimate the cost of each type of material on the list and the total material cost.
4. Using General Contractors Estimator or sample estimators guide determine the approximate time and labor cost for completing the given job (task).
5. Determine any extra cost items (height, access restrictions, etc.).
6. Prepare total cost estimates for job.

Test

Items Needed:
1. Blueprint or detailed sketch for a shop or field project
2. Catalog and sample price list
3. General Contractors Estimator or sample estimator's guide
4. Paper
5. Pencil

Task:
1. Prepare estimated material lists.
2. Prepare labor cost sheets.
3. Estimate the cost of new fabrication.

Standard: Cost estimates for labor and material will be ± 20% of the instructor's.

Learning Activities

1. Make a list of the items to be included when estimating the cost of new fabrication. (Such as, time schedule, material, equipment.)

2. Obtain a blueprint of an object to be fabricated (assigned by your instructor).

   a. Make a list of types and sizes of material needed to fabricate the object.
   b. Make a list of all tasks required to fabricate the object.

c. Explain your determination of items on the lists to a classmate or your instructor. Include in your explanation the possible alternative, or substitute materials.

3. Materials Estimating:

   a. Obtain the appropriate catalog or price list.
   b. Locate each item in the catalog. Record the price next to the appropriate item on your list.
   c. Total the cost of all items to determine the total cost of materials.
   d. Add tax costs.

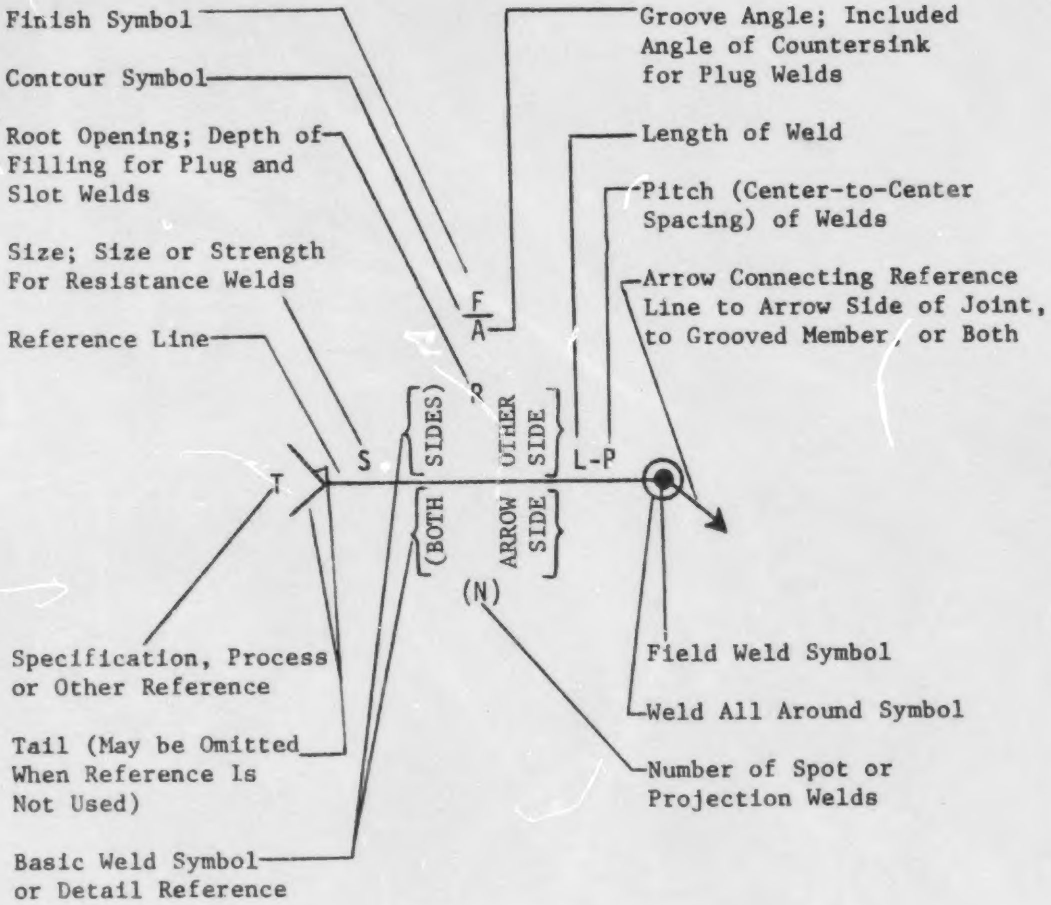
4. Labor Cost Estimating:

   a. Obtain an estimator's guide or a proto-type cost. Estimate material handling and fabrication time.
   b. Obtain from your instructor (or contact or visit a local industry to obtain) the established hourly rate for the type of job you are estimating.
   c. Calculate the labor cost. (Multiply the time regained by the average hourly rate.)

5. Total the cost of the fabrication (materials cost plus labor cost). Have your instructor inspect and approve your estimate.

Information Sheet IX-A-1

Welding Symbols


Finish Symbol
Contour Symbol
Root Opening; Depth of Filling for Plug and Slot Welds
Size; Size or Strength For Resistance Welds
Reference Line
Specification, Process or Other Reference
Tail (May be Omitted When Reference Is Not Used)
Basic Weld Symbol or Detail Reference
Groove Angle; Included Angle of Countersink for Plug Welds
Length of Weld
Pitch (Center-to-Center Spacing) of Welds
Arrow Connecting Reference Line to Arrow Side of Joint, to Grooved Member, or Both
Field Weld Symbol
Weld All Around Symbol
Number of Spot or Projection Welds
F
A
R
S
T
L-P
(BOTH SIDES)
OTHER SIDE
ARROW SIDE
(N)

Student Competency Sheet

Unit IX: SUPERVISION, TRAINING, AND JOB ESTIMATING

Module A: Job Estimating

Task 2: ESTIMATE COST OF REPAIRS

Performance Checklist

1. Estimate tear down cleaning and grinding time.
2. Estimate reassembly time (if required).
3. Determine type and length of welds.
4. Estimate labor and materials used for the welds.
5. Total the cost of each estimate above and prepare a job cost estimate sheet.

Test

Items Needed:
1. Two (2) different broken machine parts requiring welding
2. Two (2) job cost estimate sheets
3. Paper
4. Pencil

Task:
1. Estimate the cost of repairs.
2. Write a job cost estimate sheet.

Standard: The cost estimate will be within 20% of the instructor's estimate.

Learning Activities

1. Obtain one broken machine part from your instructor.
   a. Determine the type(s) of materials to be welded, using the visual or the spark test. Your instructor must agree with your determination of:
      (1) Type of material.
      (2) The welding process to be used to make repairs.

2. a. Estimate the time required for tearing down, cleaning, and grinding (joint preparation). Record the time required on a cost estimate sheet.
   b. Check your time estimate by actually tearing down, cleaning, and grinding the machine part. Write the actual time on the cost estimate sheet. Compare with your estimate.

3. a. Estimate preparation time (such as, pre-heat, fixturing, etc.). Record your estimate on the cost estimate sheet.
   b. Check your time estimate by preparing the part. Write the actual time on the cost estimate sheet. Compare with your estimate.

4. a. Estimate the type and amount of weld deposit. Record your estimate on the cost estimate sheet.
   b. Make the required weld. Write the actual time and material cost on the cost estimate sheet. Compare with your estimate.

5. a. Estimate the costs involved in the post-weld procedure (such as, post-heating, grinding, painting, etc.) Record your estimate on the cost estimate sheet.
   b. Perform the necessary post-welding operations. Write the actual time on the cost estimate sheet. Compare with your estimate.

6. Total the actual time involved. Calculate the cost. Record on the cost estimate sheet.

7. Total the estimates for the cost for materials.

8. a. Total the time and materials costs for the necessary repair job.
   b. Write a complete cost estimate sheet, using the figures from the activities above.

9. Present your cost estimate sheet to a classmate, or your instructor. This person will play the role of the customer. Give him/her a rational explanation for the cost. Be professional and diplomatic, even though he/she will question your estimate.

10. Obtain from your instructor a different broken machine part. Estimate the cost of repairs and record your estimates on a cost estimate sheet. (This time, do not perform the work.) Your instructor must agree with both the time and materials costs and the total cost on your estimate.

Student Competency Sheet

Unit IX: SUPERVISION, TRAINING, AND JOB ESTIMATING

Module B: Training

Task 1: WRITE PERFORMANCE STANDARDS FOR JOBS

Performance Checklist

1. Review the task in question.
2. Research technical publications.
3. Prepare description of task.
4. Observe step-by-step process of the task of any three (3) employees who have demonstrated proficiency in the task.
5. Maintain time standards on the steps to task completion.
6. Determine average time for successful completion of task.
7. Write the description of the performance standard.

Test

Items Needed:
1. Three (3) selected tasks in the field of combination welding
2. Technical publications
3. Paper
4. Pencil

Task:
1. Write performance standards for each of the three (3) selected tasks.
2. The standards you write must represent the minimum acceptable performance for that task in accordance with nationally established codes (American Welding Society, American Society of Mechanical Engineers, or local building codes).

Standard: Your findings must agree with your instructor's

Learning Activities

1. Read Procedure Handbook of Arc Welding, pp. 24-1 to 24-5.

2. Your instructor will assign three (3) tasks:

   a. Watch a classmate perform the tasks. Observe and record each step.
   b. Write each list of performance steps on a separate sheet of paper.
   c. Compare your lists with those of another observer, with the person you observed, and with your instructor's.

3. Identify types of materials used for each of the three (3) tasks (Learning Activity 2). Add this information to your lists of performance steps.

4. Write the welding method and procedure used for each task (Learning Activity 2). Add this information to your lists of performance steps and materials.

5. Read and outline the appropriate code for each task (Learning Activity 2). Add this information to the above lists.

6. Perform the tasks you observed:

   a. Each task must be performed to code specifications.
   b. For each task, estimate the time it would take for three (3) qualified welders to complete the task (instead of one).

7. From information you assembled in Learning Activities 1 through 6, write a performance standard for each of the three (3) tasks.

   a. Have your instructor evaluate your work.
   b. Compare your performance standards with those of classmates.

Student Competency Sheet

Unit IX: SUPERVISION, TRAINING, AND JOB ESTIMATING

Module B: Training

Task 2: PLAN AND CONDUCT ON-THE-JOB TRAINING FOR EMPLOYEES

Performance Checklist

1. Plan training session.
    a. Determine method of presentation, such as lecture, demonstration, and performance.
    b. Determine required equipment and supplies.
    c. Determine time for training session.
    d. Schedule location for training session.
    e. Notify participants of training session.
2. Gather equipment and supplies.
3. Explain and demonstrate, if appropriate, procedures and equipment.
4. Provide opportunity for trainee's questions.
5. Provide opportunity for trainee practice through demonstration and performance.
6. Evaluate trainee's performance.
7. Reteach if necessary.

Test

Items Needed:
1. Equipment and supplies necessary to demonstrate the procedure
2. Training procedures
3. Trainees

Task:
1. Plan training presentation.
2. Determine equipment and supplies needed.
3. Instruct employees so they can perform required tasks.

Standard: All items listed on the Check Sheet must be rated satisfactory by your instructor.

Learning Activities

1. Observe your instructor's teaching methods. Take notes: list the methods used, such as lecture, audio-visual aids, demonstrations, etc.

2. Select a training topic:

    a. Work with two or three classmates to plan a training session.

   b. Suggestion: plan, prepare, and conduct the training session on one of the three (3) tasks you were assigned in Unit IX-B-1 (Write Performance Standards for Jobs).
   c. Review your topic with your instructor.

3. Read books or other materials on the welding procedures, safety, etc.

4. Obtain equipment/supplies/materials needed to conduct the training session:

   a. Make a list of necessary equipment/supplies/materials.
   b. Set up equipment/supplies/materials.
   c. Practice using the equipment. Review your plan for presenting training procedures.

5. Working with your team, practice conducting the training session. Evaluate each other's performance. Pay particular attention to whether:

   a. The procedures are presented in logical sequence.
   b. Equipment is explained, including safety requirements.
   c. Choice of materials and supplies is clearly explained.
   d. Voice is loud enough and words are clearly pronounced.
   e. Instructions are understood. (As you and your team take turns performing segments of the training practice, play the role of someone who has never done the task before.)
   f. Be sure all items on the Instructor Check Sheet (IX-B-2) are covered.

6. Conduct the training session. All items on the Instructor Check Sheet must be rated acceptable by your instructor.

7. As others in the class conduct training sessions, conduct your own evaluation.

Unit IX-Module B

INSTRUCTOR CHECK SHEET: Place date activity is completed and approved in Approved column. Rate quality of performance 1 to 4 (1 is poor) in Quality column.

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
1. Lesson based on approved job requirements						
2. Style of presentation consistent with performance expected of employees.						
3. Trainees notified in advance of time and place.						
4. Equipment to support presentation set up and available.						
5. All teaching points were covered in the presentation.						
6. Student knowledges were adequately sampled and correctness of responses provided.						
7. Each student was required to demonstrate skill.						

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Student Competency Sheet

Unit IX: SUPERVISION, TRAINING, AND JOB ESTIMATING

Module B: Training

Task 3: CONDUCT ORAL SAFETY BRIEFINGS

Performance Checklist

1. Select OSHA hand book and state and local safety codes.
2. Determine applicable references.
3. Prepare outline of safety briefing.
4. Present oral safety briefing.

Test

Items Needed:	1. Occupational Safety and Health Act (OSHA) Handbook 2. Local safety standards 3. State safety standards 4. Paper 5. Pencil
Task:	1. Prepare an outline for a safety briefing. (Give a copy to your instructor.) 2. Give an oral safety briefing.
Standards:	1. Briefing will be clear and concise. 2. Briefing will follow your outline exactly.

Learning Activities

1. Read Welding Principles and Practices (Sacks), pp. 453-468.
   a. Answer the questions on pp. 467-468.
   b. Discuss the answers with the class.

2. Read:
   a. Occupational Safety and Health Act (OSHA) handbook.
   b. State and local standards.

3. Write a safety checklist for a section of your shop (as assigned by your instructor).

4. With several classmates, prepare a safety checklist for a welding shop.

5. Use the checklist (Learning Activity 4) to safety rate a shop:

    a. Rate your school shop.
    b. Rate a local shop.

6. Use information from your readings and safety observations to write an outline for a safety briefing for each of the following:

    a. Use of a piece of equipment
    b. A welding procedure
    c. A welding shop

7. Follow one (1) of the outlines (Learning Activity 6) to practice giving a safety briefing. Ask two (2) classmates to be your audience and to evaluate your briefing.

8. Follow one (1) of the outlines (Learning Activity 6) to give an oral safety briefing to your class. Your instructor will evaluate your performance.

Student Competency Sheet

Unit IX: SUPERVISION, TRAINING, AND JOB ESTIMATING

Module B: Training

Task 4: IMPROVE WORK METHODS

Performance Checklist

1. Identify the task.
2. Analyze task or work method to be improved.
3. Write the steps necessary for performance.
4. Identify task limitations for different skilled workers.
5. Observe work methods of skilled worker performing.
6. Review work procedure already established for the task, if applicable.
7. Analyze time elements in task completion.
8. Rate steps in task in terms of difficulty.
9. Use the above research to write a new, or improve the present, work method.

Test

Items Needed:

1. An identified task which will improve job or shop work methods
2. Occupational Safety and Health Act (OSHA) Handbook
3. Local and state safety standards
4. Paper
5. Pencil

Task:

1. Analyze this task.
2. Write specifications. Include:
   a. Sequential steps
   b. Skill required for performance
   c. Safety precautions required
   d. New or different techniques to be used
   e. Standards of performance for both the worker and the product
3. Develop written instructions to improve work methods.

Standard: Instructor must agree that the instructions will improve the work method for the identified task.

Learning Activities

1. Read Handbook for Analyzing Jobs (U.S. Department of Labor, Manpower Administration, 1972): pp. 2-3, 11-14, 25-32, 60, 73-83, 104-108, OR another guide to job analysis assigned by your instructor.

2. Select or have your instructor assign a task or work method to be improved.

3. Analyze the task and plan improvement procedure:

    a. Identify each phase of the task to be performed.
    b. Determine the method to be used to perform the task.
    c. Write the steps necessary to perform the task in the order of their difficulty. Include the performance standards and safety precautions.

4. Assign personnel to perform the steps of the task, according to their ability. Instruct them in the new procedure(s).

5. Observe and analyze the workers' performance:

    a. Record your observation of the workers' performance.
    b. Review and record your observations of the results of their performance.
    c. Determine the time factor for each task.

6. Compare the results of the new procedure with the old procedure. Write a report and/or give an oral presentation to the class.

7. Rate each phase of the old procedure, in terms of difficulty. Then:

    a. Rate each phase of the new procedure, in terms of difficulty.
    b. Compare the ratings.

8. Read Handbook for Analyzing Jobs, pp. 62-88.

9. Compile the results, in written form, for your procedure to improve the work method.

10. Write a procedure, based on your findings (as presented in the written report). Include the performance standards and safety precautions. Your instructor will evaluate your work.

Student Competency Sheet

Unit IX: SUPERVISION, TRAINING, AND JOB ESTIMATING

Module C: Supervision

Task 1: PLAN AND SCHEDULE WORK ASSIGNMENTS

Performance Checklist

1. Determine and list work requirements.
2. Determine priorities of work:
   a. What has to be done immediately.
   b. What has to be done by the end of the day.
   c. What has to be done in two (2) days, etc.
3. Plan work according to priorities.
4. Schedule work for specific employees according to skill.

Test

Items Needed:
1. Two (2) shop situations
2. Work assignments to plan and schedule
3. Paper
4. Pencil

Task: Make a schedule for each case situation:
   a. List name of employee to perform each task.
   b. List the order in which tasks are to be completed.

Standard: All items on the Check Sheet must receive an acceptable rating from your instructor.

Learning Activities

1. a. Obtain from your instructor a list of jobs to be completed in a shop during a one-week period (Monday through Friday).
   b. On separate sheets of paper, subdivide the list into jobs that must be completed:
      (1) immediately
      (2) by the end of Monday
      (3) by the end of Tuesday
      (4) by the end of Wednesday
      (5) by the end of Thursday
      (6) by the end of Friday

2. Write a plan for each job. List the tasks and all requirements, such as equipment, material, number of employees needed to complete the job.

3. Rate each job plan, according to its difficulty.

4. Assign personnel to each task according to their skill level. Explain work assignments to each person.

5. Prepare the work schedule:

   a. Include the name of the employee.
   b. Include the task and the work in the order of priority and completion deadline.
   c. Time should be assigned to each phase of the project.
   d. Include the total time projected for the completed plan.

6. Have your instructor evaluate your plan and schedule of work assignments. All items on the Instructor Check Sheet (IX-C-1) must be rated acceptable.

Unit IX – Module C

INSTRUCTOR CHECK SHEET: Place date activity is completed and approved in Approved column. Rate quality of performance 1 to 4 (1 is poor) in Quality column.

ACTIVITY	DATE APPROVED	QUALITY				NUMBER OF ATTEMPTS
		1	2	3	4	
1. Assigned logical priorities to work.						
2. Planned work according to employees skills.						
3. Planned work load in equitable manner.						
4. Scheduled adequate time for task completion.						
5. Met required deadlines.						

Student Competency Sheet

Unit IX: SUPERVISION, TRAINING, AND JOB ESTIMATING

Module C: Supervision

Task 2: ASSIGN WORK TO OTHERS

Performance Checklist

1. Give complete and clear instructions with respect to:
    a. Blueprint or detailed sketch.
    b. Priority of work.
    c. Material to be used.
    d. How the job will be accomplished.
2. Relate in a manner which is pleasant but will motivate workers.

Test

Items Needed:	1.	A written work order requiring multiple tasks such as cutting, layout, repairing, fabricating and testing.
	2.	Blueprint or detailed sketch.
Task:		Assign work to other welders.
Standard:	1.	Instructions must be clear.
	2.	Instructor must agree that performance is acceptable based on the following: a. Assignments must be workable. b. Materials must be available. c. Assignments must match the skills of the workers. d. Time schedule must be reasonable to do the job.

Learning Activities

1. Read the assigned blueprint (or detailed sketch) carefully.

2. Read and analyze the written work order. Then:

    a. Make a list of tasks to be performed.
    b. Review the skill levels of workers to be assigned to each task.
    c. Match the skill level of the workers to the difficulty of the tasks; assign workers to the tasks, writing their names beside the tasks on your list.

3. Plan work site set up:

    a. Inventory the material and equipment necessary for the project.
    b. Check for the availability of work space.

4. Discuss your plan and your interpretation of the blueprint requirements with a classmate or your instructor.

5. Write the work procedure schedule. Explain the schedule to a classmate or to your class.

6. Explain the job in detail to workers assigned to the tasks. Answer all questions on all phases of the project.

7. Your instructor will evaluate your written plan and the manner in which you instruct the workers.

Student Competency Sheet

Unit IX: SUPERVISION, TRAINING, AND JOB ESTIMATING

Module C: Supervision

Task 3: PREPARE ANNUAL SHOP BUDGET

Performance Checklist

1. Review previous year's shop expenditures:
    a. Salaries
    b. Equipment
    c. Supplies
    d. Building Maintenance
    e. Vehicle Maintenance
    f. Utilities
2. Review previous year's total receipts.
3. Calculate projected expenditures for coming year to include possible increases in salaries and cost increases for materials (same categories as in No. 1 above).
4. Calculate total expected receipts for coming year.
5. Prepare budgetary forms and justification for all increases in expenditures.

Test

Items Needed:
1. Last year's total shop expenditures
2. Last year's total shop receipts
3. Annual budget
4. Projected figures for:
    a. Salaries
    b. Supplies
    c. Equipment
    d. Building Maintenance
    e. Vehicles Maintenance
    f. Utilities and anticipated receipts for the coming year
5. Paper
6. Budget forms
7. Pencil
8. Equipment and supplies catalogs/price lists
9. Current job contracts

Task: Prepare an annual shop budget.

Standard: The completed budget must:
1. Be mathematically correct.
2. Show anticipated receipts greater than expenditures.
3. Clearly state justifications for expenditures where applicable.

Learning Activities

1. Attend a lecture-discussion on the purposes and importance of a written budget, when it should be prepared, and by whom.

2. Invite an accountant or an accounting teacher to speak to the class.

3. Study a budget used in a welding operation. Discuss the items included.

4. Obtain a sample budget from your instructor. Review it. Then, on a work draft, record:

   a. Previous year's expenditures covering:
      (1) Salary
      (2) Equipment
      (3) Supplies
      (4) Building maintenance
      (5) Vehicle maintenance
      (6) Utilities
   b. Total receipts from previous year

5. Obtain and review a list of existing contracts, regular and anticipated customer needs, and anticipated project receipts for the coming year.

6. Work with a partner. Write a budget based on the data you collected and supply justification where necessary.

   a. Review the budget with your instructor.
   b. Make suggested revisions.
   c. Have your instructor evaluate the revised budget.

Student Competency Sheet

Unit IX: SUPERVISION, TRAINING, AND JOB ESTIMATING

Module C: Supervision

Task 4: RECEIVE AND RECORD NEW SHIPMENT OF SUPPLIES

Performance Checklist

1. Get original requisition or purchase order.
2. Get shipper's packing list.
3. Check supplies against shipper's list.
4. Check shipper's list against original requisition.
5. Store supplies in proper place.
6. Update the master inventory as required.

Test

Items Needed:
1. An incoming shipment of supplies
2. Shipping list
3. Original requisition (purchase order)
4. Storage shelves (area)
5. Pencil

Task: Receive and inventory new shipment of supplies.

Standard:
1. The items received must be those listed on the purchase order.
2. All discrepancies must be noted.

Learning Activities

1. Attend a lecture-discussion on preparing and processing requisitions/purchase orders.

2. Review several equipment and supply catalogs. Compare item information in the catalogs with information needed on a requisition/purchase order.

   a. Inventory supplies and equipment in the school shop; determine items which need to be replenished.
   b. Prepare a purchase order or requisition.
   c. Have your instructor check your work.

3. Help your instructor check in a supply order:

   a. Compare the purchase order number with shipping list number.
   b. Check each item of those supplies delivered against the purchase order
   c. Make note of back orders and/or shortages. File the information, as specified by your instructor.

   d. If any items are damaged, notify your instructor. (In the working shop, you would notify the carrier.)
   e. Place all items in proper storage area.
   f. Update the inventory to include the new shipment.
   g. Have your instructor evaluate your performance.

4. Practice the procedure for reporting damaged items:

   a. Use a telephone to notify a local "carrier." (A classmate may role-play the carrier.)
   b. Write a letter to the carrier, listing all damaged items. Include dates, numbers, description, condition, etc.

Student Competency Sheet

Unit IX: SUPERVISION, TRAINING, AND JOB ESTIMATING

Module C: Supervision

Task 5: INTERVIEW JOB APPLICANTS

Performance Checklist

1. Review job description.
2. Review completed prospective employee application forms.
3. Observe filmed interview techniques.
4. Complete an evaluation sheet on the filmed interviews.

Test

Items Needed:
1. A job description for a combination welding technician
2. Checklist
3. Two (2) completed employee application forms
4. A short film clip of two (2) interviews
5. Pencil

Task: Use the written job description and the completed employee application forms. Evaluate the filmed interviews according to the checklist.

Standard: Your evaluation of interviews must match your instructor's evaluation on at least 15 of the items.

Learning Activities

Part I

1. Discuss with your class the characteristics of a "good" employee. (Refer to Unit A--Employment Opportunities.)

2. Discuss the qualifications you would look for in a new employee.

3. With the class, write an evaluation form you would use to rate job applicants.

Part II

1. Read a job description provided by your instructor. Record highlights of the job description. Give value to major phrases of the description.

2. Study the two (2) employee application forms (provided by your instructor) as they relate to the job description. Make notes of the applicants' major accomplishments, previous employment, abilities, and other qualifications.

3. View the filmed interviews. (You may use the Singer Job Survival Skills Program Unit XIII--Interview found in Unit A, Task 4 of this curriculum; or use a filmed interview provided by your instructor.)

   a. Take notes of interviewing techniques.
   b. Discuss other interviewing techniques.
   c. Fill out the evaluation form (Part I, Learning Activity 3).
   d. With the class, discuss your evaluation.

OR; If filmed interviews are not available:

4. Ask two (2) classmates to complete employee application forms.

5. Ask a classmate to act as the interviewer for the two (2) "job applicants." Make notes of:

   a. Interview technique.
   b. Applicants' responses and behavior.

6. Write an evaluation of the interviews.

7. Discuss the interviews with the role-play team (interviewer and applicants).

Part III

1. Now that you have practiced interviewing welders, attend another class discussion on interviewing techniques and employee selection.

2. Review the module (Unit A-- Employment Opportunities).

3. Your instructor will provide another job description.

4. Write three (3) checklists:

   a. Necessary employee job skill qualifications.
   b. Desirable personal qualifications or characteristics.
   c. An interview outline of:
      (1) What you will ask the applicant.
      (2) What you will observe in the applicant's answers and behavior during the interview.
   d. Discuss your checklists with classmates.
   e. Have your instructor review and approve your checklists.

5. Ask two classmates to complete employee application forms:

   a. Interview the applicants.
   b. Your instructor will observe and evaluate your interview technique.

6. Evaluate the applicants in terms of:
    a. The job description requirements.
    b. The application forms (content, neatness, etc.).
    c. The interviews (appearance, knowledge of the job, experience, your judgment of the applicants' reliability and ability to do the job, etc.).

7. Select the person to be hired:
    a. Discuss your selection with the instructor.
    b. Justify your selection in terms of your checklists.
    c. Your instructor must approve your reasons for employee selection.

Part IV

1. Discuss the employee application file: how long should you keep job applications? What do you do with the application of someone you hire?

2. Discuss the ethics/courtesy/ and method of notifying applicants who are not hired.

3. Discuss methods of notifying applicants of their acceptance.

4. Discuss forms and procedures necessary to add new employees to the payroll.

Student Competency Sheet

Unit IX: SUPERVISION, TRAINING, AND JOB ESTIMATING

Module C: Supervision

Task 6: PREPARE ACCIDENT REPORT

Performance Checklist

1. Collect information related to accident.
2. Obtain necessary personal data.
3. Complete report form(s) in compliance with statutory regulations of the state and local area served.
4. Recheck data and proofread.
5. Remit form(s) to appropriate agency.

Test

Items Needed:
1. Two (2) copies of an accident report form.
2. Pen
3. Source of appropriate data related to accident. (Witnesses, victim, etc.)
4. State and local regulations about reporting accident

Task: Prepare the accident report in duplicate.

Standard: All items on the form must either be completed or marked "not applicable."

Learning Activities

1. Attend a lecture by your instructor on accident reporting. Discuss:
   a. Federal, state, and/or local regulations about reporting an accident.
   b. Where to obtain and where to file accident reports.
   c. Insurance and Workmen's Compensation.
2. Under the direction of your instructor, work with several classmates to role-play an accident scene, OR, watch others role-play an accident scene.
3. Interview the person(s) involved in the accident. Interview witnesses to the accident. Write all information as it is given:
   a. Who was involved? Who were the witnesses? (Name and address)
   b. What happened? (What was the employee doing? Why?)
   c. Where did the accident occur? (Draw a map showing location of the victim, equipment, or any other pertinent information.)

    d. When did the accident occur? (Exact time and date; weather conditions if it occurred out-of-doors.)
    e. How did the accident happen? (Make note of who gives the testimony, where they were standing in relation to the accident, etc.)

4. Write a report of the accident. Include all of the above information (Learning Activity 3). Have your instructor check your report.

5. Complete an accident report form. (Type the report or print clearly with a pen.)

    a. Check the form against your written report. Be sure the information is factual and complete.
    b. Submit the accident report to the appropriate agency (your instructor). Keep the required number of copies for the company files, or as directed on the form. (Keep a copy for your own file.)
    c. Your instructor will evaluate your work.